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ELECTRICAL WORLD AND ENGINEER.

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FEATURES OF EXPORT TRADE.

It is interesting and encouraging to note that while certain countries in Europe who are our best customers for mechanical and electrical apparatus are suffering severely from trade depression, the demand for such goods still continues brisk. Indeed, it may be questioned whether the need for economy in production due to lower prices does not of itself act as a stimulus to the purchase of better labor-saving machinery. In the meantime, it can be affirmed without fear of contradiction that no one here views with pleasure the distress existing in some parts of Europe, notably Germany. On selfish grounds alone a return to prosperity is to be desired, for it is hard to conceive of an America long prosperous while Europe, its best customer, has lost purchasing power. A better understanding and a fuller reciprocity are the needs of the hour in our international trade, and it is a hopeful sign of the time that a reciprocity convention will be held in Washington this month under the auspices of the important American Manufacturers' Association.

Turning from large issues to minor details, we cannot refrain from calling attention to the letter of Mr. Alexander, from London, in which he points out some of the conditions to be met in export trade. The suggestions he makes are in general excellent, and many of them obvious. Others might be mentioned, such as the careful packing of goods destined to be shipped considerable distances, as indicated by our weekly record of electrical exports, the apparatus often being of a rather delicate and fragile nature. These things cannot all be learned at once, perhaps, it being another case of "solving the problem as you go," but the successful cultivation of a larger international trade evidently depends quite appreciably on these points alluded to in the letter from London.

RECOGNITION BY YALE.

It is with a feeling akin perhaps to disappointment that in reading over the names of the sixty-two gentlemen honored for their scholarship and other attainments at the bi-centennial at Yale University last week, we find among them no representative of applied science, in the fields either of engineering or of invention. Yale has so long occupied a pre-eminent position among our institutions of learning, has shown such a broad and progressive spirit in educational matters and has been so truly representative of the highest American ideals in education and public duty, that not only her own graduates but those of other colleges look to her to lead in the recognition of intellectual progress wherever gained. Surely the alma mater of Eli Whitney, the inventor of the cotton gin, and of Samuel F. B. Morse, of telegraph fame, not to mention many others who have passed from her portals to win renown for her as well as for themselves in scientific research and in the broadening of engineering knowledge, should be the first to recognize the value of such achievements and the benefits conferred by them on humanity at large. America has been pre-eminently the home of inventive genius and applied science. To this has been due in large part its present dominating influence in the industrial and political world, and men like Alexander Graham Bell, Thomas A. Edison, Edward Weston, George Westinghouse, Elihu Thomson, Nikola Tesla and Frank J. Sprague, who have done so much to make this condition possible, causing ten blades of grass to grow where one grew before, have certainly contributed in no small measure to the world's resources of knowledge and happiness. Such services if performed in Great Britain or Germany would undoubt-

edly have been recognized by knighthood or other preferment by the crown, by whom conspicuous merit in engineering and invention has been rewarded in this way in numerous notable instances.

These remarks apply with equal force, of course, to all branches of engineering work, inclusive of electrical engineering. Those who have followed the work accomplished by our different institutes, such as that of the Electrical Engineers, or the societies of Mechanical or Civil Engineers, recognize that these bodies really exercise the function of great post-graduate schools in which the members, who are continuously engaged in technical work, have done more to advance the science than any other agency. If more of the instructors or professors at Yale were members of the American Institute of Electrical Engineers this fact might be better understood at New Haven. For this reason, the president of each of these bodies stands in the position of a president of a post-graduate school for the advanced study of a particular branch of engineering, so that it would be a graceful act for some of the leading universities occasionally to recognize this fact by the award of a degree to the president of one of these bodies when the occupant of that position has been particularly prominent for scholarly attainments, or for engineering achievement.

POWER FACTOR INDICATION.

Elsewhere we print an account by Mr. George T. Hanchett, of an interesting method of measuring the power factor of an alternating-current circuit, the chief value of which resides in the fact that its application requires no other instrument than the ordinary alternating-current voltmeter. As will be noted, however, there is some complication in arranging the circuits, and while this is not a grave objection to the method, yet it sets a limitation to its general use. Perhaps the greatest value of the method is that it furnishes a means available to all who own an alternating-current voltmeter, for calibrating a power factor indicator of the Tuma type, which instrument is so simple in its parts that its construction comes easily within the range of amateur skill. An account of the principles of this type of indicator will be found in an article by Mr. Aug. J. Bowie, which appeared in our issue of Oct. 27, 1900, and also in a paper read by Professor William Hand Browne, Jr., before the Buffalo meeting of the American Institute of Electrical Engineers, and reprinted in our issue of Sept. 7. Briefly, the indicator consists of two coils secured at an angle on a shaft, and movable in a magnetic field maintained by a current derived from the main circuit. The two coils are connected across the circuit of which the power factor is to be measured. The conductor from the latter has two branches, one of which includes one of the angularly displaced coils and an inductance, and the other the second coil and a non-inductive resistance, which disposition results in a displacement of the phase of the currents flowing through the coils. If the several data involved be accurately calculated, the angle indicated by the instrument will be the actual angle of phase displacement. If, however, means are at hand for calibration such as is offered by Mr. Hanchett's method, it will merely be necessary to insert enough inductance and resistance to give rise to a considerable phase difference in the currents flowing through the two coils. The article by Mr. Bowie above referred to, gives the application of this type of indicator to both single-phase and polyphase circuits.

THE RISE OF THE ELECTRIC MOTOR.

Mr. Adams' recent paper on the growth of electric lighting is admirably supplemented by the examination of motive power statistics published elsewhere in our columns. The data from Massachusetts are complete enough to give a clear view of the situation, although, of course, the figures from Boston dominate the total so completely that it was wise to separate them as Mr. Adams has done. The statistics show the growth not only of the business but of the art as well. The use of the electric motor first came in with the extension of the arc lighting business. Once electric circuits were available the motor came quickly into use, and by the time low-tension incandescent systems were fairly under way they took a hand in the business. At first electrical energy was a rather costly commodity, and it is natural enough to find that the early motors were on the average of small output. On the constant-current system any motor of more than a very few horse-power was not only a burden to its circuit, but a source of serious danger. These objections very quickly told against the arc-circuit motor, and within its practicable radius of distribution the low-tension constant-potential system had a firm grasp of the situation. Alternating-current systems were few and alternating motors were practically non-existent.

Probably the real stimulus that did most for the growth of the electric motor service was the sudden and sensational boom in electric railways that took place a little more than a decade since. Not only did this serve as a demonstration that electric motors were of downright practical value, but it put trolley circuits within general reach. There was an immediate effort to utilize them for general motor service, which was promptly squelched by the fire underwriters wherever they had the power. They would gladly have done the same bad turn for electric lighting *in toto* a few years before, but the dangers of working motors off a grounded circuit were appreciated even by the unbiased general public, and the motor on railway circuits had to go. The demand for it, however, pointed out an important opportunity for business, and the special power circuit was very rapidly developed, with excellent results. It has grown in later years side by side with the growth of service on incandescent circuits until at the present time it includes about two-fifths of the total number of motors installed. The next step in the advance of the art was the introduction of the polyphase motor. By the time of its advent, however, the direct-current systems were so thoroughly intrenched behind ramparts of invested capital and vested rights that outside of isolated plants in which they are not uncommon, polyphase motors cut very little figure in Massachusetts statistics. Nor for the same reason will they for some time to come play an important part where large cities are the main field of motor service. In the older States distributed industry is dying out, and the cities grow relatively more important so that the future of electric motive power depends on the policy and methods of a few large stations.

Elsewhere, in California, for example, the story of the growth of electric motor service would be equally instructive, but very different. It would tell of early use of constant-current motors, of special power circuits arranged for them, and vigorous competition with constant-potential motors. The latter pushed out the former slowly and with some difficulty as the low-tension networks gradually spread out and reached more and more customers. But long before the constant-current motor was exterminated the polyphase motor came into use and took a very important place in the extension of the industry. These motors must be for the most part added to the list of motors on incandescent circuits, for while separate motor circuits are sometimes run, their existence is due either to extraordinary conditions as to demands for power, or to a pottering and incompetent management in the matter of regulation. To revert to Massachusetts, the increase in the motor business has been very irregular. If the figures are to be trusted the growth in 1899-1900 was almost entirely in large motors, arranging over 10 horse-power each, and less than half as many motors were added as in the previous year. In Boston for 1899-1900 there is clear evidence of the increasing use of large motors.

In fact, it is safe to say that the whole recent tendency is to extend electric motor service into the larger industries, and this is con-

spicuously the encouraging side of the business. The small motor field has been pretty well worked already, but there is still ample opportunity for displacing gas engines and small steam engines with excellent economic results. It is to this work that central stations must now address themselves. As to methods we are inclined to think that the special power circuit is doomed to decay. It is a relic of the days when a thousand-light alternator was looked upon as a colossus, and three-wire mains were installed with No. 0 wire. With modern machines and methods of dealing with regulation, a separate motor system is simply a nuisance, tolerated because for the time being it is cheaper to keep it going than to drop it. The increasing use of larger motors may sometimes cause temporary difficulties, but generating units and distribution mains are growing faster than motors, so that this phase of the matter can be trusted to take care of itself. The future of the motor business is a very great one, both in its commercial possibilities and its physical importance. More than this, it bears a momentous relation to civic progress, for it is by far the most considerable factor in the struggle against the smoke nuisance. The various articles in our present issue, as to motor use, will doubtless be noted with general interest.

THE VARIATIONS IN SPEED OF PARALLEL-DRIVEN ALTERNATORS.

Several interesting papers on this important subject, of which abstracts appear on other pages, were read before the American Institute of Electrical Engineers last week. In the early days of direct-current central-station practice, there was considerable difficulty with the operation of direct-current dynamos in parallel, when each machine was driven by a separate steam engine. When the first engine and dynamo were brought into action everything went smoothly enough. As soon as the second dynamo was thrown into circuit, oscillations in pressure and speed sometimes manifested themselves. The ammeters in the circuits of the two respective generators showed that sometimes one dynamo carried almost the entire load, and that occasionally the dissymmetry went so far as to produce a reverse current through the under-loaded machine tending to make it run as a motor or auxiliary of its own engine. The difficulty was traced to the steam engine governors, and when these were adjusted, all serious hunting disappeared. A certain small amount of hunting between direct-current generators is yet, however, to be observed in some direct-current central stations, due to the uncorrected residue of the original difficulty.

In the case of two direct-current generators driven at equal internal e. m. f. and connected in parallel on the same load, the law of relative load distribution is that the armature drops shall be equal, thus leaving their terminal e. m. f.'s equal. This means that if their armature resistances are equal, the load current will be equal, and if their armature resistances are unequal the load currents will be inversely proportional to the said resistances. Expressing the proposition in another way, the load current among a number of direct-current generator armatures operated at constant equal internal e. m. f., will be directly proportional to the conductances of the said armatures. In a similar manner, if two alternators are driven at constant equal frequency and cophase e. m. f. on a common load, the law of their operation is that the drops in their armatures shall be equal, leaving their terminal pressures equal. Since the reactance of the armatures is always much greater than the resistance, the armature resistances have relatively little influence upon the drop, and the armature reactances exercise the controlling influence. Consequently, if the two machines have equal synchronous reactance, they will divide the load equally, and if the reactances differ, the load current will be approximately inversely proportional to the respective reactances. Expressing the proposition in another way, when a number of alternators are driven with constant equal frequency and cophase e. m. f. on the same load, as when a number of alternator armatures are rigidly coupled on the same shaft, the load currents in the various armatures will be approximately directly proportional to the armature synchronous susceptances. If the direct-current machines are not driven at equal speeds and e. m. f.'s, but one of them is varied with respect to the others, the share of load increases with the e. m. f. until, when the terminal e. m. f. of the leading generator is equal to the internal e. m. f. of the neighboring machines, all the load is carried by that generator. Since the fundamental law of the engine governor is that as the speed increases the steam power diminishes, the regulation of the multiple-unit system becomes stable provided that the percentage speed regulation limits of each engine shall be less than the percentage of e. m. f. drop in each armature. If, however, the governors are liable to hunt under load, each engine may in turn carry all the load periodically and leave the others idle.

With alternators driven in parallel, without any assumption as to equal and constant speed, whichever engine accelerates will carry an undue share of the load, both by reason of the higher induced e. m. f., and of the advance in the phase of that e. m. f. This will tend automatically to retard the speed and the governor will also tend to reduce the steam supply. Assuming that the governor is dead-beat in its movements, a certain interval of time must elapse between the accidental acceleration of the engine and the reduction of its supply of steam power by the action of the governor. This lag in reactive force combined with the inertia of the moving mechanism is equivalent to the production of a pendulum of such nature that any accidental disturbance of the speed of the engine, such as might accompany a sudden variation of load, would give rise to a succession of periodic variations in speeds alternately above and below the speed of uniform governing. If the electric circuit of the alternator, by reason of its apparent inductance and capacity, happens to have the same natural periodic time as that of the equivalent pendulum formed by the engine and governor, the conditions of operation will be unstable and resonance will occur between the mechanical pendulum on the one hand and the electrical pendulum on the other. In such a case there may be cumulative oscillation and surging of the alternator or alternators with dead-beat governors. If, however, the governors are not dead-beat, that is to say, if a retardation in speed of the engine will cause the governor to move beyond the restoration point and pass to the accelerative side, then the power delivered to the engine may become periodic, and if the period of steam fluctuation is approximately coincident with the period of the moving parts considered as a pendulum, violent cumulative surgings may be looked for even if there is no electric periodic storage of energy.

In either case, therefore, the necessity exists of preventing the coincidence of the period of the moving parts of the engine mechanism with the period of the electric circuit, on the one hand, or with the period of the governor on the other. Mr. Emmet has undoubtedly hit upon the general solution of the latter problem, by producing a dash-pot connected with the governor in such a manner, that while the governor is capable of responding to slow and steadily prolonged retardation or acceleration, it is practically incapable of responding to swift and sudden variations in speed. This virutally means that the governor period is artificially rendered much longer than the natural period of oscillation of the moving parts of the engine considered as a pendulum. This is, perhaps, also the reason why Mr. Emmet finds it better to dispense with heavy flywheels, because heavy flywheels increase the inertia of the moving parts of the engine as a whole, and tend to make the natural period of oscillation of the moving parts greater, or their vibration slower. This would call for a still lower period of vibration in the engine governor, and a still further automatic locking of its parts, than if the engine were provided with less inertia, and a smaller flywheel.

Electric Omnibusses for New York City.

Mr. Henry Sanderson, president of the New York Electric Vehicle Transportation Company, which will operate the new stages, says: "Within four weeks our company will, it is expected, have eight electric stages in service in Fifth Avenue, running between Bleecker and Eighty-eighth streets. The present horse stages will be withdrawn. We expected to have the new stages for use before this time, but there has been delay in their construction. One of the smaller electric stages is completed, and the seven others like it contracted for will be ready within four weeks.

"These stages will accommodate 12 persons inside and 5 passengers on top, in addition to the driver. We are also having two large 'double-deckers' built, which will have seating capacity for 34 persons. We have had two electric stages running in Fifth Avenue between Eighty-eighth Street and 135th Street since Jan. 1. As the business develops we shall increase the number of stages on that part of the route.

"We are making trial trips with one of the smaller stages for the purpose of making up a time schedule, and expect to cut down the present horse schedule nearly one-half."

The new electric stage already completed is a great improvement over the antiquated horse stage. It is much wider than the old vehicle. The roof is high enough to permit a tall man to stand erect.

The body of the vehicle is painted a dark olive, while the running work is yellow, striped with black. The driver wears a dark blue uniform with brass buttons and the customary automobile cap. The vehicle was used successfully in the automobile ride given to the ladies of the American Street Railway at the time of the recent convention.

Electrical Engineers of the Day—XVIII.

R. N. BAYLIS.

Electrical engineering being the youngest of the engineering professions, it is natural that it should have been taken up by many whose original interests and training were in the older branches of mechanical and civil engineering. Among the well known electrical engineers whose career is an example of this kind of experience and capacity, is Mr. Robert Nelson Baylis, who has combined to a marked extent in his work both the mechanical and electrical branches of the profession. Mr. Baylis was born on March 16, 1867, at Englewood, N. J,. where he received his early education at private schools preparatory to entering Stevens' Institute, from which he graduated with the degree of M. E. in 1887.

After leaving college, Mr. Baylis entered the shops of the Southwark Foundry & Machine Company, in Philadelphia, as an apprentice. Here he went through all the drudgery and hard work of a machinist's helper, acquiring a thorough knowledge of the practical machine shop work. Many men who go into the machine shop as apprentices for the purpose of learning the practical work, become disgusted after a short time, or, at all events, do not get the full benefit of the experience, from the fact that the natural tendency of foremen and others is to keep them at one kind of work. This very often is the fault of the apprentice himself, who is frquently lacking in either the ability or the energy rapidly to graduate from one branch to another. Mr. Baylis exhibited both of these qualities to such a degree that in something like a year he had advanced from the lowest work through the various grades of hand chipping and bench work to the handling of the large and important machine tools.

In January, 1890, Mr. Baylis left Philadelphia to take a position as draughtsman and engineer with the C & C Electric Motor Company, of New York. His first work was naturally in the line of handling the mechanical design of the electrical machinery of that company, and the effect of his sound mechanical training and judgment became at once apparent in the larger sizes of motors and dynamos brought out by this company at that time. From this time onward Mr. Baylis gave his chief attention to electrical work, and finally became chief engineer and factory manager of the C & C Company.

It was at this time that he devised the ingenious "reaction" brush holder which was such a radical departure from all previous devices of the kind, that when it was first introduced it aroused endless arguments as to whether the carbon could possibly remain in the holder when the machine was in motion. Mr. Baylis introduced numerous improvements into the factory methods and management of his company.

In the spring of 1893 Mr. Baylis left the C & C Company, going to Chicago, where he remained until the following winter, making a thorough study of the engineering work at the World's Fair. During this time he was associated with the late Charles E. Emery and others in the elaborate tests that were made of the intramural power station.

Having devoted a great deal of attention to street railway work, which at that time was increasing enormously, Mr. Baylis was requested by the Walker Company to examine some of its plants with a view to improving the equipment. Later he took charge of the Walker Company's exhibit at the Atlanta Fair, at the conclusion of which he went to Cleveland, becoming shortly afterward chief electrical engineer of the Walker Company.

At this time the great extension of electrical railway systems all over the country had brought about a great demand for electric railway apparatus of all kinds, including power generators of much greater capacity than had heretofore been used in this class of work. So rapid had been the advance in the electric railway field that engineers and designers had not had time thoroughly to investigate all the practical requirements of railway service, and many designers did

not realize the arduous requirement of such service. The natural result was that in getting this experience many mistakes were made in design and construction of apparatus with consequent breakdowns and interruption of service. In many cases generators constructed on the same lines as had been found successful for electric lighting work, were used in railway service and were found to be entirely inadequate to meet the conditions. Mr. Baylis' first step after taking charge of the electrical design for the Walker Company was to make a thorough investigation of the actual conditions of operation of the electric railways all over the country, and by personal inspection to determine the practical requirements of the service. Having satisfied himself on these points he proceeded to design railway generators on a much more liberal scale than had been heretofore practiced, and the extremely heavy and substantial railway generators, for which the Walker Company was noted, were largely the result.

Mr. Baylis remained with the Walker Company until the spring of 1897, when he resigned his position and returned to New York. He did not, however, sever his connection entirely, but acted for the company as technical expert in many of the patent suits in which it became involved.

In 1898 Mr. Baylis formed with his brother the firm known as The Baylis Company, for the purpose of carrying on a general engineering and contract business. Finding that there was a large demand from motor builders and users for the Baylis reaction brush holder. The Baylis Company went into the manufacture of these holders, and have since then branched out into the manufacture of various other mechanical devices and specialties.

Mr. Baylis is a member of the American Society of Mechanical Engineers and the American Institute of Electrical Engineers, being a member of the Board of Examiners of the latter.

Electric Power Distribution in a U. S. Navy Yard.

THE construction department of the Brooklyn Navy Yard has recently been engaged in changing the motive power in its shops from steam to electric motor drives, in most cases applying the well-known method of equipping each tool or group of tools with its own electric motor, and thereby eliminating the line shafting. The results have been gratifying and the department is so well pleased that it is contemplating further applications of electric motors. The character of the equipment and the results obtained certainly justify this attitude, and a discussion of them forms the subject of what follows.

The most extensive portion of this installation comprises a large carpenter shop, which is equipped with Thresher motors, and it is ultimately intended to supply the same with power from two 200-kw Thresher generators direct connected to McIntosh & Seymour engines. In the further extensions which are contemplated, motors which are near the distributing center will be supplied with power at 110 volts, while distant motors will receive their power at 220 volts. The carpenter shop comprises the following equipment, which is listed in detail herewith because it is believed that the powers of the motors found to be satisfactory in operating the various devices will be of interest. Two band saws, 15 horse-power each; one jig saw, 2 horse-power; one emery wheel, 2 horse-power; one plug cutter, 5 horse-power; one circular saw, 5 horse-power; one circular saw, 15 horse-power; one band saw, 15 horse-power; shafting carrying several grindstones, 5 horse-power; one log shifter, 25 horse-power; 1 surface planer, 5 horse-power; one surface planer, 15 horse-power; one surface planer, 20 horse-power; one surface planer, 25 horse-power; one four-sided planer, 50 horse-power; one large log saw, 100 horse-power.

This plant has displaced about 210 ft. of jack shafting and a quarter-turn mule, together with a 12 by 12 engine and boiler equipment. Beside doing away with the maintenance and the annoyance of these devices, the comparative coal economy, figuring electric power on the basis of 5 lbs. of coal per horse-power-hour, is 4.3 to 12. That is to say, the plant is now operated on about one-third the coal that was previously used.

Besides this, a comparison of labor accounts shows a still further saving.

The former equipment comprised the following daily items: Engineer, $3.12; fireman, $2.48; oiler, $2, or a total daily charge of $7.60. This service is replaced by services of an electrical inspector who devotes a small portion of his time to examination and keeping up the motor equipment, which is figured in at about $1 per day, thus representing a daily saving on labor account of $6.60.

The accompanying illustrations show typical motors used in the installation and their methods of control. In Fig. 2 is shown a 100-hp motor, which operates a large circular saw. Its speed is 600 r. p. m., and it is a good representation of what is called the "open" type of motor in the test tables which appear beyond. This motor is placed on the lower floor of the carpenter shop and belted upward, as shown in the cut. It is started and controlled from the second story, where the large log saw is located. Fig. 3 illustrates the controller board, which is one of the Cutler-Hammer multi-switch type. That is to

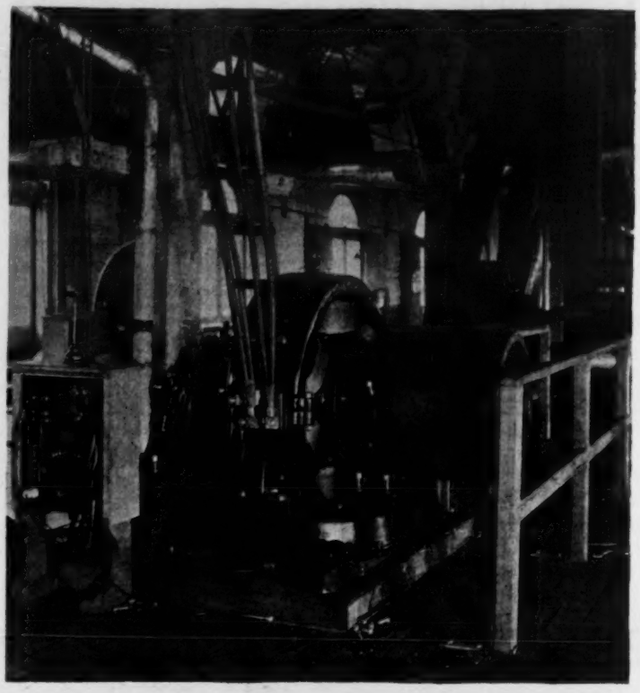


FIG. 2.—100-HP MOTOR ON SAW, 600 R. P. M.

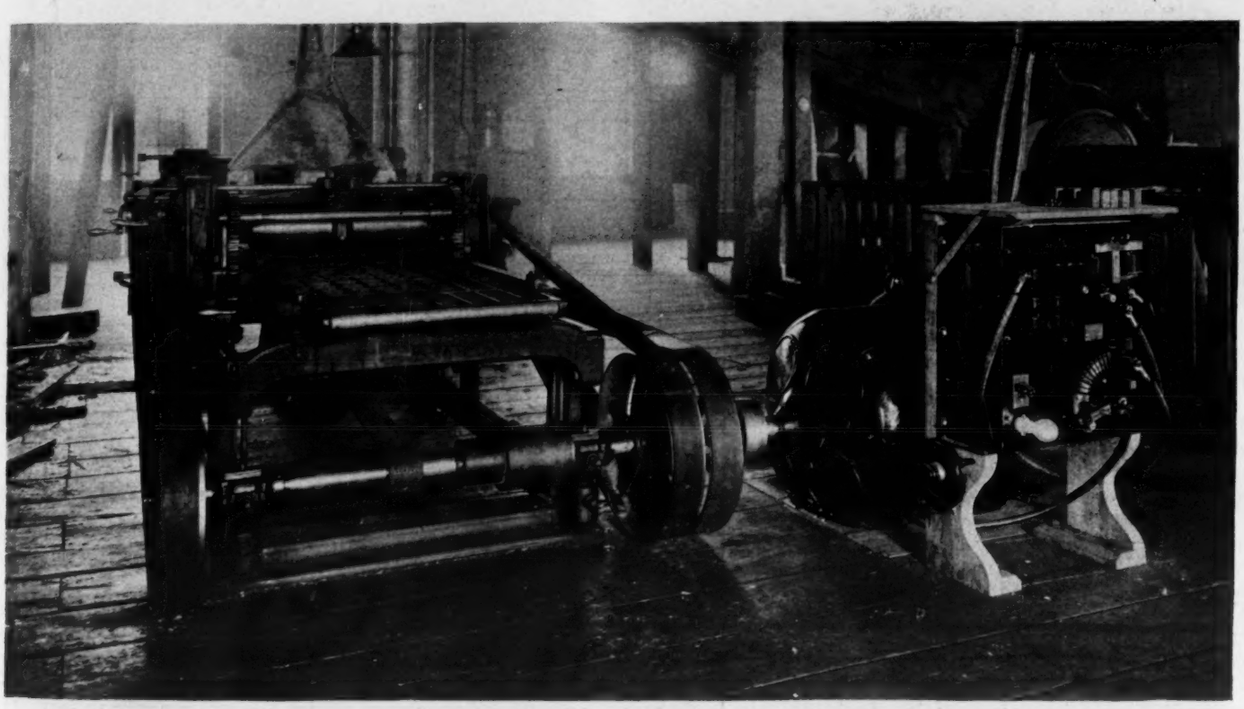


FIG. 1.—PLANER DRIVEN BY 20-HP MOTOR, 550 TO 800 R. P. M.

say, the rheostat points instead of being arranged to switch in with a lever in the customary way, are manipulated by a succession of switches which appear in the middle of the board. The first switch gives the motor full field, and closes the armature circuit through all the resistance, and the succeeding switches cut the resistance out point by point. A system of latches is provided so that it is impossible to throw one switch until its predecessor is closed, unless by deliberate intent. A low-voltage release magnet controls the first switch, and if that switch is thrown open, it unlocks and releases all others, thereby stopping the motor. At the top of the board is a time-limit circuit breaker, which deserves mention.

The main contacts are made through a laminated spring jaw pressing upon two rectangular blocks set in the surface of the board. The auxiliary contacts which take the arc are heavy carbon blocks set between magnetic poles which effectively extinguish the arc. The circuit breaker opens quite widely, thereby making the arc very attenuated, and the strong magnetic field cutting across it renders its rupture certain. The auxiliary contacts are shielded from the main contacts by appropriate plates of insulating material. The latch of the breaker has a roller contact, which acts on the time limit principle. The tripping coil has quite a number of turns and does not carry the full series current, but only a portion that is deflected around the shunt. The time element, therefore, enters on account of the period that must elapse before the temperature of the shunt rises and increases its resistance sufficiently to put a potential difference on the tripping coil adequate to actuate it. The lower switch, which cuts off everything, is also interesting inasmuch as it exhibits a departure from the ordinary jack-knife plan, and favors the laminated contact method, the laminations being held in place by a latch which is tripped by a slight pull on the handle which also serves to close the switch.

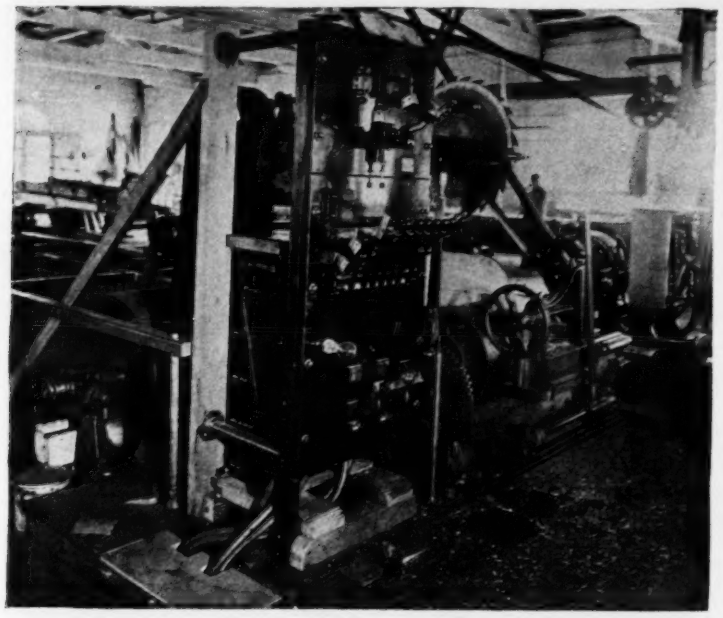


FIG. 3.—CONTROLLER PANEL.

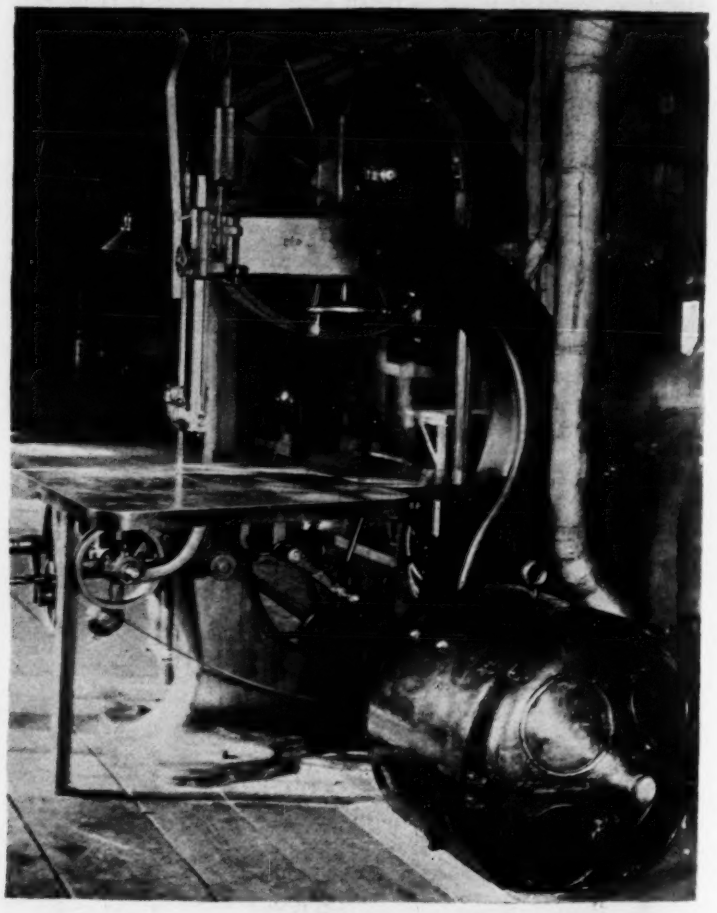


FIG. 4.—BAND SAW, 15-HP MOTOR.

Referring to these illustrations, it is only just to say that the construction department is contemplating building a new carpenter shop, and hence the wiring has been executed in a temporary manner, which though thorough is not representative of its customary methods of installation.

Fig. 4 shows an enclosed motor directly connected to a band saw, and, in fact, wherever possible the motor is directly connected to the tool without the medium of belts or gears. This motor is enclosed in every sense of the word, this feature being carried to such a degree that the doors over the commutator and other parts of the motor are rubber gasketed and held in place by screw pressure. If the bearings were provided with stuffing boxes, the motor could be immersed in water without injury. This complete enclosure of the motor makes it somewhat larger for its capacity than would otherwise be the case, because the machine must get rid of its heat entirely by conduction through its casing, and has no ventilation whatever. The temperature figures, as will be noted in the table beyond, are, however, exceedingly low and compare very favorably with the open type of motor, and for the enclosed type employed are quite remarkable. This complete enclosure is believed to be necessary because the carpentry department is full of combustible dust and light, inflammable material, which it is specially desirable to keep from danger of ignition.

The small motors are all controlled by means of Cutler-Hammer controller boards of the type shown in Fig. 5, which incidentally shows the motor connected to a horizontal planer. This controller board consists of a switch, a circuit breaker and starting box, with low voltage release conveniently and neatly mounted on slate board. The 50-hp planer, however, is an exception to the usual shop arrangement. Two 25-hp motors are used, either of which alone drives the planer on light work, and they are connected in series or parallel by an automatic switchboard of a somewhat unusual type.

This board, which was designed by Mr. Frank P. Lewis, master electrician of the construction department, acts on a relay system. The master controller resembles a small starting box, and supplies current to the solenoid bobbins shown on the board above. The first step of the controller closes only the lower solenoid, giving both motors full field. The next connects the motors in series by means of two of the upper switches and gives voltage to the armature with all the resistance in circuit. On the next two steps the two other lower bobbins act, cutting out the resistance in two successive steps; still another bobbin at the next step cuts a resistance in series with the shunt field, thereby weakening it and increasing the speed of the motors. The next step connects the motors in parallel and opens all of the lower switches except the main switch and thereby restores all resistance to the line, and strengthens the field, and successive steps repeat the operations that have been described on the series notches. It will be noted that the switches making a change from series to parallel are mechanically as well as electrically connected so that the closing of one set necessitates that the other shall be open and eliminates possible sticking and therefore avoids short circuit that would occur if both sets should be closed together. As these two motors are powerful and the circuits feeding them correspondingly large, this is quite a necessary precaution, and has proven very effective.

The following table gives test data of most of the motors used in the installation. The first division is devoted to manufacturer's specifications. The second to the test on the motor under various working loads, while the last columns give the data resulting from an overload

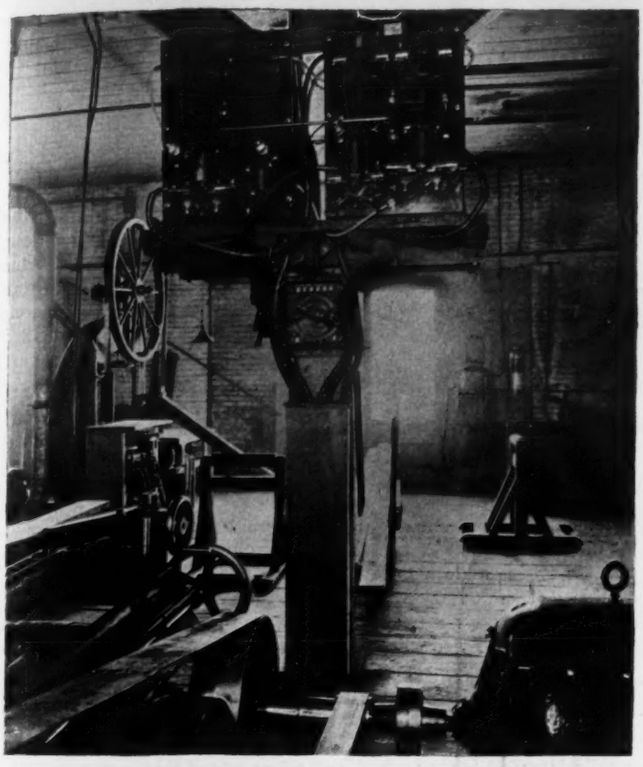


FIG. 5.—25-HP MOTOR CONTROLLER BOARD.

test. The speeds with the motor hot and cold exhibit notably small differences, which are in part accounted for by temperature figures given beyond.

Commenting on resistance figures it may be noted that the resistance as measured by the thermometer differs quite widely from that measured by the resistance method. This is accounted for by the fact that thermometer tests were simply temperature tests of the air on the interior of the shell, while resistance tests gave the internal temperature of the coils, which was, of course, considerably higher. These tests, it is stated, are quite reliable in this respect, as they were made by one set of engineers and checked independently by another with exceedingly slight differences. Sufficient data are given in the tables to enable the designer to figure out most of the important properties of the entire motor, and as far as the enclosed motors are concerned, they represent a series which can be profitably compared, and which are interesting in view of the excellent results that have been obtained.

It is gratifying to note that even in the Navy electric motors are beginning to supersede small steam engines, both afloat and ashore, and the conveniences and economies of the installation which has just been described has rendered the replacement of wasteful steam auxiliaries still more certain. The figures of steam consumption of auxiliary shipboard engines are very formidable; 140 to 150 lbs. of water per horse-power-hour are not uncommon figures for pumps and hoists, as has been repeatedly found by engineering tests on shipboard. Besides this disconcerting consideration it must also be remembered that this condensed water goes overboard, a fact which is almost as serious as the extravagance in consumption just quoted. The present example, though one ashore, constitutes another most practical argument in favor of complete electric auxiliary power service.

Electric Roads in Berlin.

A special cable dispatch notes that it is characteristic of the Kaiser to surprise his subjects by unexpectedly taking the initiative in some matter of public importance. The outcome of the conference of Herr Kirschener, the Burgomaster, and Herr Hoffmann, the City Architect, with his Majesty at Hubertusstock shows that the Kaiser is first in the scheme of beautifying Berlin. Both these gentlemen had, on the invitation of the Emperor, gone to Hubertusstock, where they were treated right royally by his Majesty, who sent his own carriage to meet them at the railway sation and afterward regaled them with a choice dinner.

Having put his guests at their ease the Emperor entered upon the discussion of Berlin's burning questions. The project of running trams in Unter den Linden found the Kaiser unaltered in his objections. The Emperor's decision was based upon feelings of personal responsibility for the safety of the public. His Majesty pointed out that traffic is congested in that thoroughfare. The introduction of electric trams would multiply accidents. If, therefore, he gave his consent to the project he would feel responsible for every accident that occurred there.

"The best way to obviate the difficulty," urged the Emperor, "is to run the trams under ground, the passengers being taken up and down to the carriages by means of lifts, as in London.

"There they have been found to be absolutely practicable. German engineers could certainly be found to overcome any difficulties in the way of carrying out this plan."

SPECIFICATIONS

H.P.	R.P.M.	Efficiency ½	Efficiency ¾	Efficiency Full	Type	Poles	Brushes	Brushes per Holder	Brush Dimensions	Armature Diam.	Armature Slots	Armature Clear	Commutator Diam.	Commutator Length	Commutator Segments
5	1100	80	84	86	Encl	4	2	1	1 x 2	9	51	¼	6	2½	51
10	450	80	83	85	Encl	4	2	2	¾ x 2	14	51	¼	12	6	51
15	400	81	84	86	Encl	4	2	2	2 x 1	16	51	¼	12	6	51
20	800	83	85	87	Encl	4	4	3	3 x 1½	16½	140	¼	10	6	140
25	800	82	86	88	Encl	4	4	3	½ x 2½	16	120	¼	10	6¼	120
100	600	86	90	92	Open	6	6	4	2½ x 1½ / 2¼ x 1½	23	134	¼	20	10	154

LOAD TESTS

R. P. M. ¼	R. P. M. ½	R. P. M. ¾	R. P. M. Full Hot	R. P. M. Full Cold	Has run	Volts	Amp.
915	....	...	960	915	8	110	38
452	452	450	453	440	8	110	74
....	395	.. .	408	397	8	110	112
802	800	...	810	800	8	110	140
804	802	800	800	800	8	110	180
496	....	....	512	488	8	110	717

LOAD TESTS

Average R. P. M	Resistance Cold Arm.	Resistance Cold Field	Resistance Hot Arm.	Resistance Hot Field	Temperature Rise Resistance Arm.	Temperature Rise Resistance Field	Temperature Rise Thermometer Arm.	Temperature Rise Thermometer Field	Efficiencies ¼	Efficiencies ½	Efficiencies ¾	Efficiencies Full
915	.0673	137.5	.0754	157.1	28	33	63	46	....	....	....	89
450	.0369	70.9	....	81.4	....	35.3	....	....	69	83.6	88.5	88.5
390	.021	42.8	.0259	51.2	21.8	47	54	40	74	86.8	89.5	92
800	.0293	45.8	....	....	....	....	....	...	...	....	88.4	91.3
800	.0196	41.9	.0225	45.8	36	20.6	48.8	51	70.6	84	91.3	92.2
500	.00597	21.5	.0107	24.4	27	32.2	51	42	....	....	....	92.4

OVER-LOAD TESTS

Has run	Volts	Amp.	R P.M.	Resistance Hot Arm.	Resistance Hot Field	Temperature Resist. Method Arm.	Temperature Resist. Method Field	Temperature Thermometer Arm.	Temperature Thermometer Field
2	110	46	990	.077	157.1	35	33.	61	70
2	110	94	453	.0441	81.4	46	35.3	42.7	43
2	110	106	409	.024	51.1	37	47	63	42
2	110	170	800	.0339	....	38	....	70	49
2	110	221	800	.0232	45.8	42	20.6	74	50
2	110	1055	516	.01086	....	27	....	57	42

The Rise of Electric Power Distribution.

By Alton D. Adams.

HUNDREDS of thousands of horse-power are daily distributed through motors by electrical supply systems in American cities. These motors are performing almost every class of work to which mechanical power is applied, from the grinding of coffee to the operation of elevators. The sizes of motor units also present a wide range from the trifling requirements of a jeweler's lathe to 100 or more horse-power in a large factory. Electric motors by their cleanliness, convenience, safety and low cost of operation have done much to stimulate the development of small manufactures in centers of population, and have thus created for themselves a part of the field they now occupy. In larger part, however, electric motors have displaced engines of the various types on the premises of small power users in cities, thus tending to concentrate steam plants at electric stations.

This introduction of a new motive power in tens of thousands of establishments, to the displacement of old and tried equipment has taken place during little more than a decade. Electrical supply systems in cities of the United States were at first established solely to furnish light, and the distribution of mechanical power from motors was, in most cases at least, merely an afterthought. As it grew evident that demands for power could be supplied from electrical systems, motors were connected to existing circuits and machinery, designed primarily for lighting purposes. At the beginning of motor service from electric stations, comparatively few systems for the distribution of alternating current were in operation, and no practicable motors for general use with such current were available. During some years after electric power distribution from central stations grew to be common, nearly all additions of alternating generators were of the single-phase variety. Consequently, when two and three-phase alternating motors were developed most of the existing electrical supply systems were unable to serve them, even if desired to do so by their customers.

As a result of these conditions, electric motor service from central stations was inaugurated with direct currents, and necessarily continued along this line during some years thereafter. Even when the equipment of some central stations with two and three-phase generators, and the development of practicable motors for use with such machines, made the distribution of electric power from alternating currents possible, a serious impediment remained to be overcome. Consumers of electrical energy for power purposes have invested, in the aggregate, great sums for direct-current motors, and such motors are useless for work on alternating service. Naturally, power users are in no hurry to accept a kind of electric service that will destroy the greater part of their investments in direct-current motors. A further fact that operates against the general use of alternating motors is their higher price, compared with that of the direct-current type.

Two classes of direct-current circuits existed at the time when electric motors began to be supplied from central stations. These circuits were the constant-current, variable pressure type for the operation of arc lamps in series, and the constant pressure, variable current type for the supply of incandescent lamps in multiple. The arc circuits when operating at full capacity usually had pressures of 1000 to 3000 volts, approximately, the lower voltage representing the requirements of about 20, and the higher voltage of about 60 open arc lamps. The pressure on any of these arc circuits when in operation might vary all the way from that necessary for a few lamps up to the full capacity. Amperes of current in these arc circuits were usually limited to about 6.5 or 10, according to the nominal candle-powers of the lamps in use.

Constant pressure circuits were limited by incandescent lamps to approximately 125 or 250 volts, according as the two or three-wire system of distribution was used. Amperes of current in these circuits might reach any desired figure.

Each of these two classes of circuits has its own peculiar advantages and disadvantages for the distribution of power through large numbers of motors.

The constant pressure systems usually operated within a radius of one mile of their central stations, because a rapidly increasing cost of conductors made much greater extensions at their low voltages impracticable. Constant-current circuits, on the other hand, were, to a large extent, independent of the limitations of distance, and readily supplied motors up to five or more miles from their stations. Within their limited radii of operation the quality of service rendered through motors by the constant-pressure incandescent systems was all that could be desired. Most kinds of work to which mechanical power is applied require a nearly constant speed, independent of momentary changes of the load. The nature of shunt-wound motors operating on constant-pressure circuits is to maintain nearly constant speeds for all loads within their capacities, automatically, and without the aid of any regulating mechanism. A practically unlimited ampere capacity in the constant-pressure system makes it possible to supply a motor of any desired horse-power. About 250 volts, the usual pressure of a three-wire system, is too low to offer any serious danger from personal contact with the current-carrying parts. This last fact is of great importance in general distribution of power from central stations, because motors must often be placed where accidental contacts with them are probable, and be operated by unskilled persons. Furthermore, the fire risk is smaller with the low-pressure system. To offset its one advantage as to radius of service, the arc circuits lack all the good qualities of their incandescent rivals. Motors supplied with constant current do not operate at a uniform speed of revolution, unless provided with some regulating mechanism external to the motor proper. Such mechanisms are sources of trouble, and do not yield as perfect results in speed regulation as are given automatically by shunt-wound motors on constant-pressure circuits. At most, each motor on an arc circuit can have only a small capacity, because of the limitations on the circuits themselves. Take for illustration, a circuit of 3000 volts maximum pressure and 10 amperes constant current, the largest commonly used for arc lighting. The entire power of this circuit, or $3000 \times 10 = 30{,}000$ watts, when expended in a motor of 90 per cent efficiency, yields only $(30{,}000 \div 746) \times .90 = 36$ horse-power on the shaft. But the pressure of 3000 volts at the terminals of this motor, when under full load, is entirely too high for personal safety in general use. Moreover, arc circuits are primarily intended for arc lamps, and all or even a large per cent of the capacity in any case cannot usually be given up to motors.

After an experience of several years with motors on arc and incandescent circuits had demonstrated their general utility, power generators and circuits designed especially for motor service, began to come into use. The aim in thus adding independent dynamos and circuits to existing systems was to secure the advantages of power distribution from incandescent circuits without their limitations as to the radius of operation. For this purpose power generators and their circuits were originally designed and have remained at about 500 volts constant pressure. This voltage is substantially twice that of the three-wire system with 110-volt lamps, and multiplies the practicable radius of operation in that system by four, since the distance to which electrical energy may be transmitted at a given rate, with a fixed weight of conductors, varies directly as the square of the voltage employed, for a constant per cent of loss.

After the introduction of independent generators, stationary motors continued to be supplied from arc and incandescent circuits in many cases, so that the development of electric power distribution has proceeded on three distinct lines. With the foregoing facts in mind, it is the intention here to point out the general movement in each of these lines, and the total result. For this purpose the records of the numbers of motors supplied from arc, incandescent and power generator circuits, and their total capacity, in each year, as compiled by the Board of Gas and Electric Light Commissioners of Massachusetts, since 1887, for each city and town, are employed.

Besides Boston, Massachusetts contains a large number of cities and towns, ranging in population from more than 100,000 downwards, that are well supplied with electrical distribution systems. It, therefore, seems desirable to show the development of electric power distribution in Boston separate from that of the State as a whole. In this way it is hoped to bring out any features of the service to stationary electric motors that are peculiar to great cities. The tables given are intended to include all motors operated by electrical supply systems, except a very few in places having municipal electric plants and fan motors. A glance at the figures for the number of arc motors in use at Boston and throughout the State shows that this class of service never reached more than trifling proportions, and has already lost what little importance it once had. It is worthy of note that arc motors were used in the greatest numbers just after power generators were introduced for stationary motor circuits, that is, about the year 1890. The conclusion is obvious that the 500-volt, constant-pressure circuits sucessfully invaded the territory formerly occupied exclusively by arc lines, because beyond the reach of incandescent service. The very few arc motors now in use because of some special conditions are certain to shortly disappear.

Inspection of the tables makes it clear that the great struggle for supremacy in the field of power distribution from lighting stations has been and is between the incandescent and the purely power circuits. In this contest the incandescent circuits have the advantage of an earlier occupany of the richest portions of territory, and of the support of the lighting business.

In 1887, the first year for which records are available, the number of motors supplied from the circuits of lighting stations throughout the State was only 176. Stationary motors operated from power circuits did not appear until 1889, and in that year there were 48 such machines in use. Meantime, the number of motors connected to all circuits had increased to 538, and the number on power circuits was 8.9 per cent of this total.

Numbers, types and horse-power of stationary motors supplied from electric lighting stations in Boston.

Year ending June 30.	Motors on arc circuits.	Motors on incandescent circuits.	Motors on power circuits.	Horse-power of all motors.
1887	31	80	....	298
1888	40	104	....	405
1889	90	239	....	704
1890	81	417	....	1,326
1891	83	684	....	2,304
1892	91	960	49	3,373
1893	..	....	....	3,831
1894	45	1565	105	5,233
1895	38	1732	334	6,046
1896	28	1591	780	7,092
1897	8	1734	831	8,794
1898	6	1946	1151	10,261
1899	5	2701	901	12,330
1900	5	2467	1042	14,959

Numbers, types and horse-power of stationary motors supplied from electric lighting stations in Massachusetts.

Year ending June 30.	Motors on arc circuits.	Motors on incandescent circuits.	Motors on power circuits.	Horse-power of all motors.
1887	31	145	....	422
1888	43	193	....	614
1889	111	379	48	1,422
1890	100	579	128	2,723
1891	173	851	195	5,250
1892	104	1294	376	5,485
1893	..	....	530	6,848
1894	142	2031	591	8,944
1895	69	2365	1067	10,924
1896	54	2293	1688	13,930
1897	29	2505	1928	16,318
1898	10	2775	2235	18,930
1899	6	3742	2171	22,740
1900	11	3735	2572	27,133

After 1889 the per cent of motors operated from power circuits rapidly increased up to the middle of 1898, when it stood at 44.6. During the year following this last named date the number of motors operated from power circuits declined to 36.6 per cent of the total, but rose to 40.7 per cent in the following year.

Per cent of all motors in Massachusetts on power circuits.

Year.	Per Cent.	Year.	Per Cent.
1889	8.9	1895	30.4
1890	15.8	1896	41.8
1891	16.0	1897	43.2
1892	21.2	1898	44.6
1893	....	1899	36.6
1894	21.4	1900	40.7

The corresponding per cent is given in the table for each year of the period except 1893. Some data for important stations is lacking for that year, and any conclusions drawn from the remainder would be misleading.

No motors on power circuits are recorded for Boston until 1892, when 4.4 per cent of the total number there were so operated. As was the case for the entire State, the proportion of motors operated from power circuits at Boston advanced rapidly up to 1898, standing at 37.1 per cent of the total for that year. From the middle of 1898 to the like date in 1899 the number of motors served from power circuits in Boston fell back to 24.95 per cent of the total, but rose to 29.6 per cent during the following year. The similar change noted for all the motors in the State during the same year can be traced mostly to Boston, for while the number of motors on incandescent lines in the entire State went up by 967, the number of similar motors at Boston increased 755. This marked change in the service of motors at Boston seems to have been due to arrangements connected with the erection of a new generating station for one of the companies there in the year named. For the year ending June 30, 1900, the number of motors served from incandescent circuits at Boston fell back by 234, while the same circuits lost only 7 motors in the entire State. The ability of the State outside of Boston to make up the loss in the number of motors on incandescent circuits in that city during the year last named is probably due to the increasing number of two and three-phase motors operated by alternating systems, as these motors are all reported under the head of incandescent.

Per cent of all motors in Boston on power circuits.

Year.	Per Cent.	Year.	Per Cent.
1892	4.4	1897	32.3
1893	....	1898	37.1
1894	6.1	1899	24.9
1895	15.9	1900	29.6
1896	32.1		

At the middle of 1887 the total capacity of motors connected to the circuits of electric lighting stations in Boston was 298 horse-power, and the like figures for the entire State were 422 horse-power. Boston at that time contained, therefore, 70.6 per cent of the capacity in motors operated from electric lighting stations in the entire State. The table gives the like per cent in each year from 1887 to 1900:

Per cent of capacity of motors operated from electric lighting stations in Boston to capacity of all such motors in the State.

Year ending June 30.	Per cent at Boston.	Year ending June 30.	Per cent at Boston.
1887	70.6	1894	58.5
1888	65.9	1895	55.3
1889	49.5	1896	50.9
1890	48.7	1897	53.3
1891	43.9	1898	54.2
1892	61.5	1899	54.3
1893	56.0	1900	51.1

The portion at Boston of total motor capacity for the State declined as stations in other cities began to supply electrical energy for power purposes, and was only 43.9 per cent in 1891. During the next fiscal year 500-volt power generators were introduced in the Boston motor field, as they had been at some other points in the State as early as 1889, and on June 30, 1892, that city contained 61.5 per cent of the total motor capacity connected to electric lighting stations in the State. This last figure is the highest ever reached for the relation of the motor load at Boston to that of all electric lighting stations, and since 1893 the load at Boston has been but little more than one-half the total. According to the census of 1900, the population of Massachusetts was 2,805,346, and of Boston 560,892. It thus appears that Boston had 20 per cent of the population of the State at the time that its electric lighting stations were operating 51.1 per cent of the stationary motor load. From this it follows that the capacity of such motors operated in Boston is $(51.1 \div .20) \div (48.9 \div .80) = 4.2$ times as great per unit of population as in the remainder of the State. As 76 per cent of the entire population of Massachusetts is in places of 8000 or more inhabitants each, the ratio above found serves to bring out the superiority of a very large city over smaller places as a field for the supply of power through electric motors.

The table shows a gradual and somewhat irregular increase in the average horse-power of all the motors connected to lighting stations throughout the State. In 1887 this average was only 2.4 horse-power, but the average for 1900 was 4.3 horse-power. Taking the five years from 1895 to 1900, their average was 3.9 horse-power. This increase

in the average size of electric motors is what might be expected, as they are applied to more important purposes with extending use.

Average horse-power of electric motors supplied from lighting stations.

Year ending June 30.	Average horse-power.	Year ending June 30.	Average horse-power.
1887	2.4	1894	3.2
1888	2.6	1895	3.1
1889	2.6	1896	3.4
1890	3.3	1897	3.7
1891	4.3	1898	4.5
1892	3.1	1899	3.6
1893	....	1900	4.3

In spite of the great capacity of electric motors connected to the circuits of lighting stations during the past few years, there are no indications that service of this sort has reached its maximum figures. On the contrary, every year except three since 1888 has shown a larger addition of motor capacity than the previous year, and the increase for 1900 was greater than that in any other year of the period.

Yearly increase of capacity in motors supplied with energy from lighting stations.

Year ending June 30.	Horse-power added during year.	Year ending June 30.	Horse-power added during year.
1888	192	1895	1980
1889	808	1896	3006
1890	1301	1897	2388
1891	2527	1898	2612
1892	235	1899	3810
1893	1363	1900	4393
1894	2096		

The fact that motors of 4393 horse-power capacity were added to the circuits of lighting stations during the last year is sufficient to show the importance of the movement.

In the three years from 1887 to 1890 the capacity of motors served from electric stations increased more than six times. For each year since 1890 the capacity of such motors has been computed as a per cent of their capacity in that year, as follows:

Year ending June 30.	Per Cent.	Year ending June 30.	Per Cent.
1890	100	1896	511
1891	192	1897	599
1892	201	1898	695
1893	251	1899	835
1894	328	1900	996
1895	401		

The total power increase during the ten years is 896 per cent of the capacity in 1890, or an average of 89.6 per cent yearly. For the year of 1900 the increase was 161 per cent of the power in 1890.

Electricity in Korea.

Mr. Horace N. Allen, United States Minister at Seoul, makes an interesting report of electrical developments in Korea. On Aug. 17, the Seoul Electric Company formally opened its electric lighting plant by turning on the power and illuminating the city by arc and incandescent lights. This lighting plant is run in connection with the electric street railway, the installation being of the polyphase system. The Seoul Electric Company is a Korean concern, but the builders and operators are American—Messrs. Collbran and Bostwick—who hold the plant on mortgage until all indebtedness is paid. This is not the first electric plant to be erected in Korea. In 1886, an Edison incandescent plant was installed in the palace, and was successfully operated until the boilers were worn out. In 1894, a new and complete plant was erected by the American electrician of the Korean Government, Thomas W. Power, but the advent of the Japan-China war prevented its use for more than a short experimental period.

A Means of Measurement of the Angle of Lag and the Power Factor with a Voltmeter.

BY GEORGE T. HANCHETT.

IT sometimes happens that an electrical expert finds himself in a situation where it is exceedingly desirable to know the power factor on a certain circuit, and the only instrument at hand is an alternating-current voltmeter. This is usually the first alternating instrument that is acquired by the electrical engineer, and it is often the case that it is the only one that he happens to have with him at the time. In view of these circumstances, the writer believes that the method outlined in the following paragraphs will serve a useful purpose, and therefore be of interest.

It is well to state at the start that the method is not valuable unless the conditions are those of constant load and power factor, such as obtain in the case of a simple inductive resistance across a constant

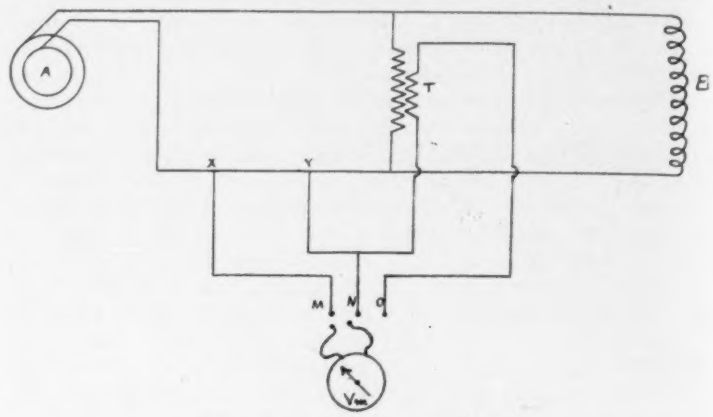
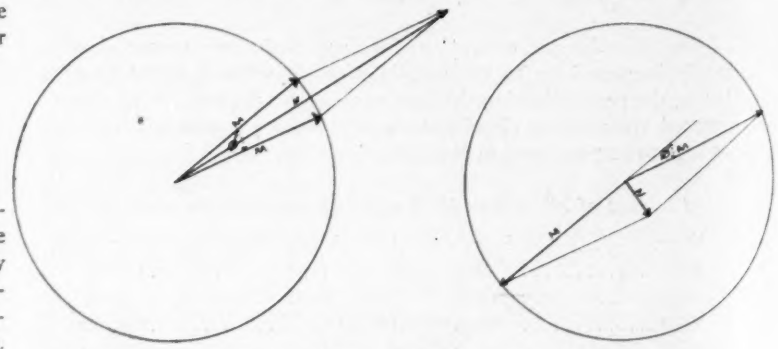


FIG. 1.—DIAGRAM OF CONNECTIONS.

potential, or in case of an induction motor driving a fan or other constant load. Three measurements and a short calculation are required, and some expediency in arranging the circuits for tests. A diagram of the connections of these are shown in Fig. 1, in which *A* is the alternator, *B* inductive load, *T* a potential transformer, which latter must be unloaded and may be of any convenient capacity. From the main circuit two leads, *X Y*, are brought out in shunt with a short non-inductive conductor of moderate resistance, such as would be furnished by a single straight piece of wire. Around the magnetic circuit of the transformer are wound a few turns of wire forming a low-voltage secondary. These turns may be of very small wire, and can consequently be threaded through a very small opening, and they require only nominal insulation. No. 26 B. & S. double cotton covered will answer nicely. If the coils of the transformer can be conveniently tapped it will answer to bring out leads, including a few turns of the secondary. It is necessary that the secondary turns, whatever the method used, be few so that the voltage obtained therefrom shall be low. The voltmeter should be a low-reading instru-



FIGS. 2 AND 3.

ment. Such an instrument is not commonly sold, but it is very easy to bring out the mechanism of the instrument to a separate binding post and insert a sufficient non-inductive resistance so that a few volts will give the entire scale deflection. This device the writer has found so exceedingly useful that he has been accustomed to equip all of his voltmeters in this simple manner.

The process is as follows: The voltmeter is applied to the terminals

of the transformer $N\ O$, and the reading is noted. Call this reading M. By means of a switch the reading of the voltmeter is then transferred to the terminals $M\ N$, and the distance between points $X\ Y$ are adjusted until the same reading as that obtained on $N\ O$ is reached. If the circuits $M\ N$ and $O\ N$ be connected together in series, these two e. m. f.'s will be combined, and a voltmeter connected across the terminals of the combined circuit will indicate the resultant of the two e. m. f.'s. It is plain that if these two forces are connected in opposition and are in phase, the resultant will be zero, and if connected in conjunction the resultant will be 2 M. If, however, the current is either lagging or leading, the resultant will be of a different value due to the fact that the two e. m. f.'s are not in phase. It is convenient to call this resultant reading N. Fig. 2 shows the condition of things when the e. m. f.'s are added, and Fig. 3 the result when they are in opposition.

From the trigonometry of these diagrams, it can be at once deduced that the angle of lag equals

$$\frac{N^2}{2M^2} - 1 = \cos\phi;$$

or in the second case

$$1 - \frac{N^2}{2M^2} = \cos\phi.$$

ϕ is the angle of lag, and can at once be obtained by reference to appropriate tables, and cosine ϕ is, of course, the desired power factor. It would be preferable to connect the e. m. f.'s in conjunction rather than opposition, because the third measurement N will then be a much larger quantity, and will give a better reading on the voltmeter scale, for the indications of an alternating-current voltmeter around zero deflection are notably non-readable.

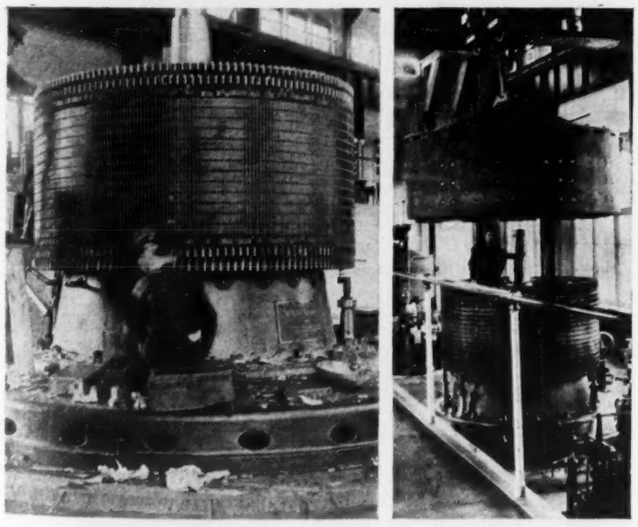
It is also plain that if the conditions are at all fluctuating, the three measurements must be made as nearly simultaneously as possible, and for that reason it is convenient to arrange a switch in order that the voltmeter may be rapidly thrown from circuit to circuit.

The number of turns on the secondary of the transformer should be chosen so as to give an e. m. f. of practically one-half of the entire scale reading of the instrument, for if a larger figure is used, the value of N may be so great as to cause the reading to exceed the range of the instrument. It is plain that this method is to be recommended more for its expediency than its convenience. It is, however, theoretically correct and practically usable under certain conditions.

The Re-winding of a 5,000 H. P. Armature.

BY ARTHUR B. WEEKS.

Fig. 1 shows a 5000-hp armature at the power house of the Niagara Falls Power Company, which was recently re-wound in five days,



FIGS. 1 AND 2.—REWINDING A NIAGARA POWER ARMATURE.

breaking all previous records. All the conductors are shown in place, extending vertically from several inches beyond the armature core, top and bottom. Tapered wooden pieces are secured between the conductors next to the core, to strengthen the bars at that point. The small openings in the core are air ducts. Hard rubber caps are fitted to the lower end of the copper bars. The top of the tapered armature shaft is shown in Fig. 1, as well as in Fig. 2.

In Fig. 2 the field ring is about to be lowered into place. The man standing on the armature sees that the proper clearance is obtained, before the field ring is lowered, by means of a 50-ton electric crane.

A force of ten men was required, working day and night (a double shift of ten men each), to complete the re-winding of this gigantic armature. To heat the soldering irons, of which a great number were used, a very ingenious method was employed. A small motor was belted to a blacksmith's forge, in which charcoal was burned—a great improvement over the former method of using gasoline soldering pots.

In recognition of the services rendered by the men employed on the re-winding, Mr. Paul M. Lincoln, electrical engineer of the company, tendered them a dinner at a local hotel, and divided among them the additional bonus of $50 above their regular wages.

The Zossen Polyphase Railway Installation for Experimental Trials with Speeds Up to 125 Miles an Hour.—VI.

BY WALTER REICHEL.
(Chief Engineer Siemens & Halske Company.)

TESTING.

THE motor installation was first tested by subjecting the primary winding to 4000 volts. The motors were then run without load under voltages from 1850 to 2000. The efficiency test with the ordinary friction brake presented some difficulty on account of the high output and high speed. Only 100 horse-power could be handled continuously, owing to violent oscillations of the brake lever, but for short periods this could be increased to 260 horse-power.

For larger outputs the method might be employed of belting the motor to a generator, the current from the latter being dissipated in resistances. Even in this case, however, difficulties would arise from the high speed of the motor as well as trouble from the journals, owing to the pull of the belt. The most suitable method is that of Kapp, in which two motors with pulleys different in diameter are connected in opposition to each other, one of the machines being run beyond synchronism as a generator, and the other below synchronism as a motor. To reduce the lateral pull the pulleys were made as large as possible, and, on account of the large circumferential velocity, they were of cast steel.

In the final experiments motors were tested up to 200 horse-power. On June 21 a test was made in which a motor worked at this load in connection with the regular car equipment, consisting of the transformers, rheostats, etc. Current for this test was taken from a 600-kw, 1300-volt, direct-connected, three-phase generator. During the time the friction brake was applied it was found that the lubrication

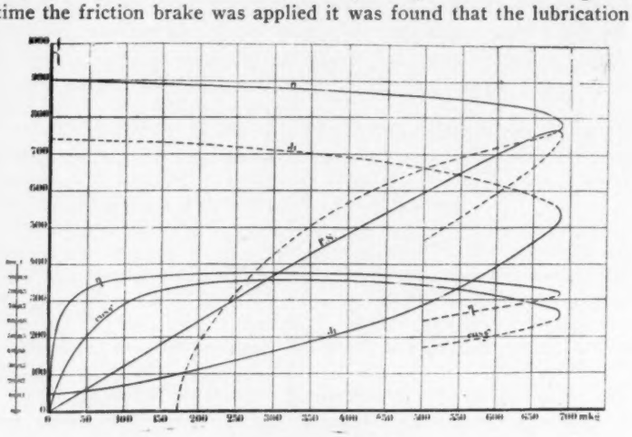


FIG. 33.—CURVES OF 1150-VOLT MOTOR.
Horse Power, P. s.; Rev. per min., n.; Primary current, J.

of the motor bearings was very good. The data taken of the total and magnetizing current, cos ϕ and efficiency were in good conformity with the calculated values as represented by the curves in Fig. 33, for 1150 volts, and in Fig. 34 for 850 volts, and also in the

circle diagrams of Figs. 35 and 36 for 1150 and 1850 volts, respectively. In constructing these latter diagrams the short-circuit current was

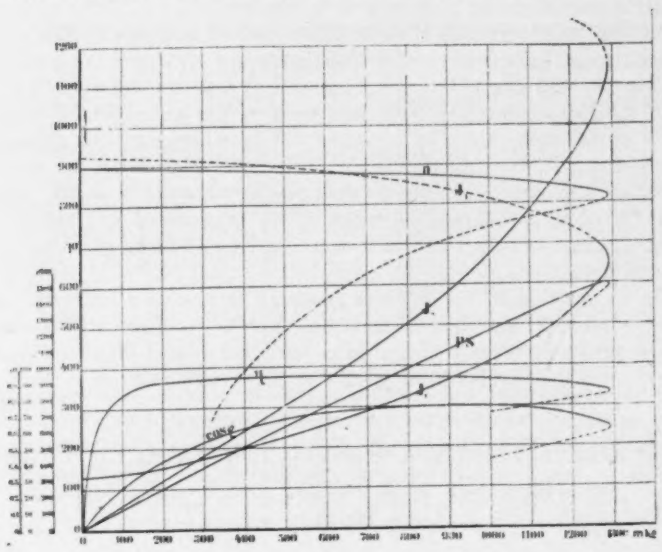


FIG. 34.—CURVES OF 1850-VOLT MOTOR.

Horse Power, P. S.; Rev. per min., n.; Primary Current, J_1; Secondary Current, J_2.

given a low value as well as cos ø and the efficiency, in order to be on the safe side.

The use of four motors on a car gives a great reserve of power, as three motors and even two would undoubtedly be sufficient for a 96-

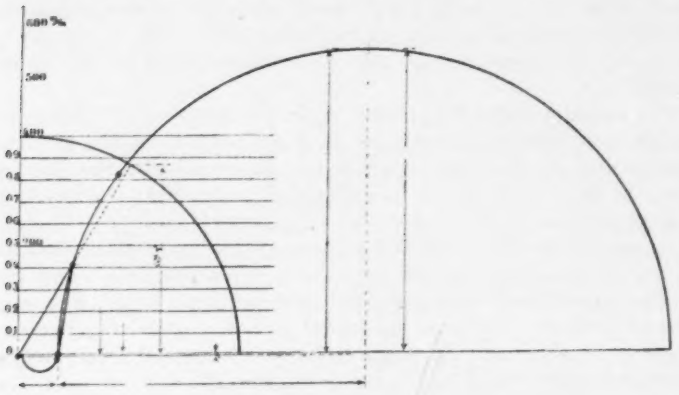


FIG. 35.—CIRCLE DIAGRAM OF 1150-VOLT MOTOR.

ton car, as may be seen from the diagrams. The special and symmetrical arrangement of the motor equipment will allow a reduction from 96 to 74 tons if the present cars should prove to be too heavy for the trial roadbed. By thus reducing to two motors, only one

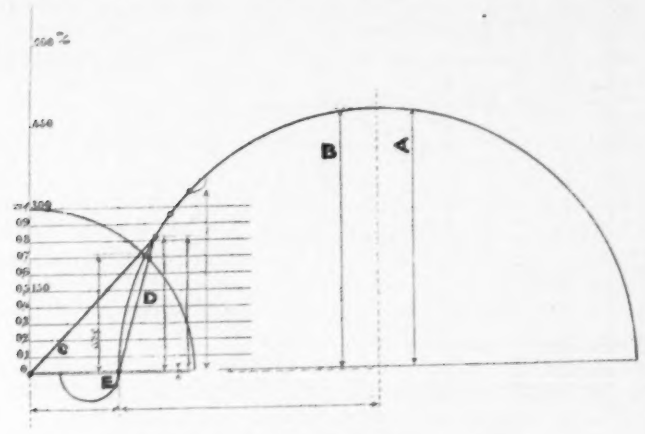


FIG. 36.—CIRCLE DIAGRAM OF 1850-VOLT MOTOR.

A, max. torque; B, working current; C, primary current; D, secondary current; E, magnetizing current.

transformer, two sets of resistances, two rheostats and one set of low-tension apparatus will be required, all of which apparatus can be placed at one end of the car and the motors at the other end, so as to give an approximately even distribution of tractional weight, which would amount to about 13.8 tons for the motor axles and 11.6 for the other axles. It is true that two motors would be somewhat heavily loaded, but they are capable of carrying the additional load and have a sufficient margin of torque.

96-TON CAR.

MOTOR	CONNECTIONS	TOTAL POWER OF MOTORS			TORQUE			SECONDARY CURRENT			ACCELERATION		
		Start	End	Mean	Start	End	Mean	Start	End	Mean	Constant	Time	Distance
		kg	kg	kg	mkg	mkg	mkg	amp	amp	amp	/sec²	sec	m
4	Star..	3840	5040	4250	600	780	665	365	490	400	0.382	150	4260
4	Delta	2000	3200	2480	310	500	390	300	530	400	0.214	270	7700
3	Star..	2700	3800	3140	560	790	645	340	500	390	0.260	220	6250
3	Delta	1500	2700	1940	315	560	405	290	550	390	0.138	410	11800
2	Star..	1540	2720	2000	490	850	625	300	540	385	0.140	405	11400

74-TON CAR.

2	Star..	1540	2720	2000	490	850	625	300	540	385	0.184	310	9100

The data for starting at full weight and at only 74 tons of car weight are given in the accompanying table, from which the curves of Figs. 37 and 38 have been plotted, the former referring to four and the latter to two, motors. The calculations are made on the supposi-

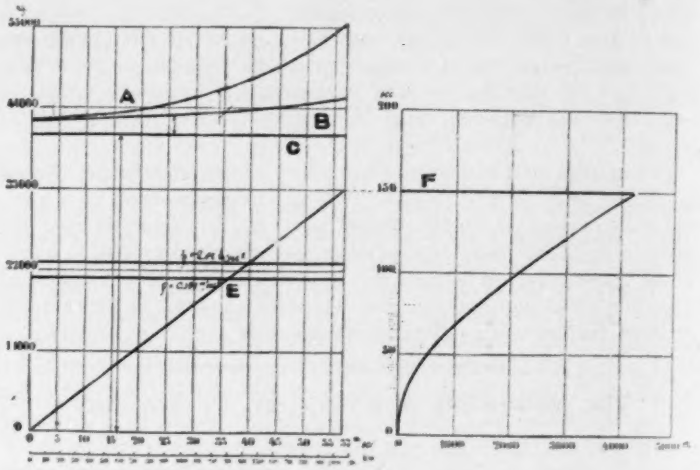


FIG. 37.—STARTING DIAGRAM.

A, available torque; B, air and traction resistance; C, traction resistance; E, accelerating time; F, total distance run.

tion that part of the torque of the motors is used to overcome the train resistance of the track and the air resistance, the rest serving to accelerate the car. From the acceleration power the acceleration constant is determined, and from this the time of acceleration to the final speed. The acceleration power is taken as constant, the torque to be developed by the motor being increased in accordance with the increasing train and air resistance. In the assumed case the initial

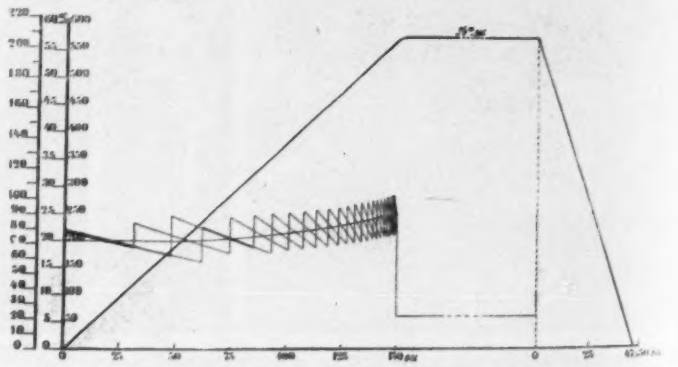


FIG. 38.—RUNNING CURVE ON LEVEL WITH FOUR MOTORS, STARTING WITH 1850 VOLTS AND RUNNING WITH 1150 VOLTS.

torque of the four motors is 3840 kilograms and the constant accelerating power 3870 kilograms. The acceleration then for 96 tons will

be .382 meters per second per second, and the time of acceleration to attain 57 meters per second per second will be 150 seconds, consequently the acceleration distance will be 4260 meters.

Figs. 39 and 40 refer to braking retardation, Fig. 39 applying to mechanical brakes, and Fig. 40 to electric brakes. The brake retardation is assisted by the gradually decreasing train and air resistances. It is assumed that the braking power is increased inversely with the decreasing resistance so that the actual retardation may remain constant. The retardation is thus represented by a straight line. Fig. 39 also indicates the amount of power on the mechanical brake shoes, which also depends on the available coefficient of friction between the shoes and steel tires for varying speeds, Weichart formula being used.

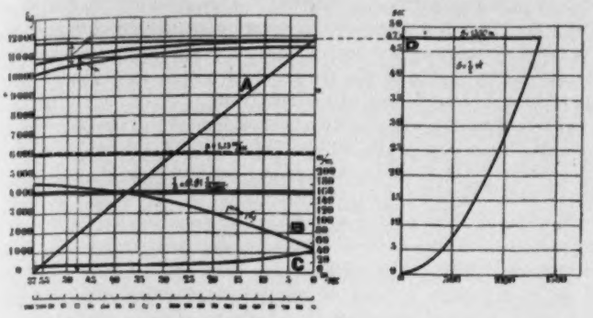


FIG. 39.—MECHANICAL BRAKING DIAGRAM.

A, time of braking; B, brake pressure in per cent of car weight; C, curve of Weichart formula; D, total braking distance.

Owing to the heat that will appear at the brake shoes it is necessary to reduce the ideal retardation of 1.23 meters per second assumed in laying down the curves, or assist the retardation by means of electric brakes. The conditions under which the curves were plotted were selected, however, in order to represent the most favorable case of braking, and for the reason that retardations of 1.1 meters per second per second are not infrequent.

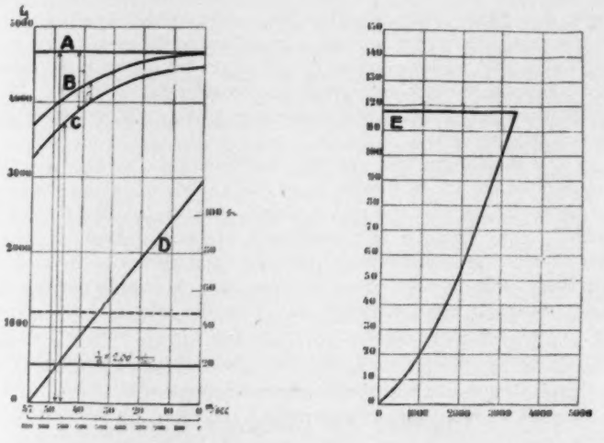


FIG. 40.—ELECTRICAL BRAKING DIAGRAM.

A, air and tractor resistance; B, traction resistance; C, electric brake pressure; D, time of braking; E, total braking distance.

In electric braking (Fig. 40), the primary winding of the motor is supplied with direct current at 26 volts, and as its resistance is .19 ohm, the corresponding current is 140 amperes. This will produce three-phase currents of 770 volts in the secondary, which are dissipated in resistances. The motor thus brakes by acting as a generator. The effect, of course, is not the same as in the case of a mechanical brake, as the braking effort is applied on only four axles. As the number of revolutions decrease the motor torque is increased by cutting out resistances from the secondary. When all the resistances are cut out, the torque of the motor quickly decreases and the electric brakes must be assisted by the mechanical brakes.

Elements of Illumination—XXXIII.

BY DR. LOUIS BELL.

IN general terms, two incandescent lamps of the same candle-power at some particular voltage will not remain equal if the voltage be changed. On the other hand, for small variations of voltage the difference will generally be so small as to be within the ordinary errors of observation, and, in fact, practically negligible. Fig. 1 shows the curves of variation of candle-power with voltage in three typical lamps of differing efficiencies. All three show an approximation to the common rough-and-ready rule of a variation of one candle-power per volt. Of course, the slope of the curves is the important consideration, and this generally decreases slightly with the efficiency of the lamp.

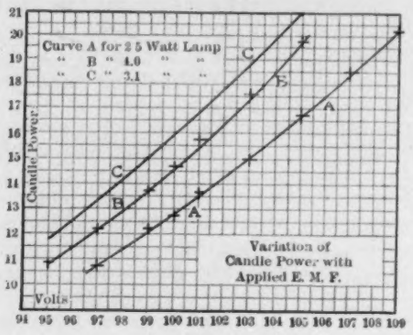


FIG. I.—CANDLE-POWER CURVES.

A brief examination discloses the relations between the curves. Suppose the working standard to be a lamp of moderate efficiency, say, 4 watts per candle, as shown in Curve B. Assuming the working voltage as 100, a rise of one volt or a fall of one volt increases or diminshes the light by as nearly as possible 85 candle-power. If the lamp under comparison corresponds to Curve A the increment or decrement is not far from .75 candle-power per volt, while with the lamp of Curve C the change is a little over .9 candle-power per volt. These three lamps represent about as large differences as will generally be found, and it is therefore safe to say that for variations of less than one volt on either side of the normal the differences in candle-power as between the lamps tested will be less than 0.1 candle-power, and for practical commercial testing may be neglected. But a difference of four or five volts would obviously lead to variations of a considerable fraction of a candle-power which would evidently be quite inadmissible.

The single-circuit method then must be used with caution, but when so used is generally quite as good as the two-circuit method, unless the latter be applied with extraordinary care. It should be remembered that unless the voltmeters employed have very open scales the ordinary errors in reading them involve errors in candle-power quite as great as those between two lamps on the same circuit under a slightly shifting voltage.

Of the two methods the writer, on the whole, prefers the single circuit one for ordinary use. It is usually easy to find a time for testing when the variations in voltage are small and slow enough to be easily reduced by a little attention to the rheostat.

It is not advisable in commercial testing to attempt the comparison of incandescent lamps with standards of another character. Such comparisons depend for their correctness on a knowledge of the absolute value of the voltage—a knowledge seldom very precise. They also introduce the factor of color difference which is enormously troublesome even with trained observers, and the full resources of a well-equipped laboratory.

When the lights compared by means of a Bunsen or Lummer Brodhun screen differ considerably in color, absolute balance is attainable at no one point on the scale. The same observer will obtain very regular apparent values for the comparison, but another observer is likely to obtain a somewhat different set of values. Such personal differences may easily amount to 5 per cent or more, if comparing, for instance, a Welsbach with a Hefner lamp, or an incandescent lamp with an enclosed arc.

There will also be considerable differences in the results with a

single observer if the absolute brightness of the colored radiants changes, even when the relative brightness remains the same. That is, if one were comparing a Welsbach and a Hefner lamp and obtained what appeared to be a satisfactory balance, that balance would be destroyed by doubling the distance of each light from the screen.

These color difficulties are physiological and subjective. They depend upon a property of vision sometimes known as Purkinje's law, stated by Von Helmholtz as follows: "Intensity of sensation is a function of the luminous intensity which differs with the kind of light."

This difficulty in color photometry is precisely akin to that involved in comparing the loudness of two noises of differing quality, although fortunately somewhat less serious. For example, one would have extreme difficulty in forming any notion of the relative loudness of a bugle note and a pistol shot, or a shout and a steam whistle. One's first instinctive effort at comparison would probably be made by investigating the distance at which each sound became inaudible or barely audible.

A similar procedure based on visual acuteness has often been tried in rough color photometry. In its crudest form it consists of noting the distance from each radiant at which a printed page held at arm's-length just becomes legible. A very little experience will convince the experimenter that the results depend upon the general state of the eye, the personal equation of the observer, practice, preconceived notions of the relative intensities and other factors so variable that the result is little better than guesswork. Yet this wildly inaccurate method has not infrequently been used in estimates of street lighting.

With proper apparatus and a careful and unprejudiced observer, however, the principle involved is capable of giving useful approximate determinations of illumination. An instrument for this purpose

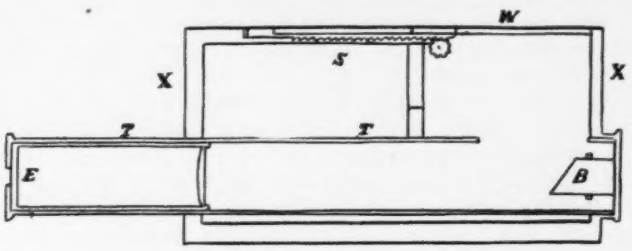


FIG. 2.—SECTION OF ILLUMINOMETER.

which has become fairly well known in this country is Houston & Kennelly's illuminometer, shown in section in Fig. 2. In the cut *X X* is a small box thoroughly blackened on the inside and provided with an eye tube *T, T*, pointing directly at a removable inclined block *B* on the face of which is placed a group of printed test characters. A focussing eye piece *E* enables any observer to see the test object distinctly. In the top of the box is a window *W* closed by a translucent diaphragm of porcelain opal glass, or the like, which serves to illuminate the test object. This window can be closed by an opaque shutter *S*, moved by a rack and pinion, the latter turned by a milled head outside the box.

The instrument is used by facing the window toward the source of illumination and opening or closing the shutter until the test characters are just legible. A scale attached to the shutter then gives the illumination directly in *bougie-metres*.

The scale is calibrated empirically by testing with a source of light of known intensity at definite distances. The instrument is small enough for the pocket, and is very convenient for relative measurements. So far as absolute values of the illumination are concerned it can hardly be considered seriously unless in experienced hands, and calibrated by the user, but in comparative measurements the average error of a single careful reading is less than 10 per cent, which is a great improvement on guesswork. A skillful observer by frequently checking the calibration of his instrument could bring the absolute errors somewhere nearly down to this figure. The question of color is partially eliminated by the great reduction in intensity of the light. As has been noted in a previous paper, color differences are inconspicuous in very faint light.

To return to photometry proper, this same expedient of reducing the intensity of the light that reaches the eye from the photometer screen is of material assistance in comparing colored lights. Observing the screen with nearly closed eyes makes comparisons very much easier, and leads to fairly consistent results. But color perception changes so notably in dim illumination that results so obtained do not represent working conditions nearly enough for results making any pretence of precision.

Numerous expedients to avoid these difficulties have been devised, all amounting in the last resort to the selection of conventional conditions, representing the practical requirements of illumination. None of them are perfectly satisfactory under all conditions, but probably the best available method is Crova's. This is based on the experimental fact that in comparing two lights even of very different color their total intensities are sensibly proportional to their relative intensities in the region of the spectrum of wave length about 0.582 μ, that is, in the clear yellow of the spectrum.

The troublesome part of such a comparison is to segregate the rays of about this wave length without resorting to spectro-photometry, which necessitates the formation of two spectra from the two sources side by side. Crova found that a solution of 22.3 grams anhydrous perchloride of iron and 27.2 grams chloride of nickel in 100 cubic centimeters of distilled water forms an absorbing screen that serves the purpose. The former constituent cuts out the green and blue, the latter the red. A layer of this standard solution 7 millimeters thick used as a screen through which to observe the photometer screen serves the purpose, although a thicker layer limits the desired region more closely.

The objection to the method is principally the large amount of light cut off by the screen so that it works best in comparing rather powerful lights.

As a matter of general practice such refinements are seldom used. Excepting arc lamps the ordinary sources of light can be compared without serious difficulty from differences of color. With flame radiants a well standardized Methven screen forms by far the best working standard, while in comparing incandescent lamps the working standard should be an incandescent of moderate efficiency.

In comparing arc lamps serious trouble is encountered. In the first place, the difference between the intensity of an arc and any feasible standard is inconveniently great, and in the second place the colors, especially in dealing with enclosed arcs. The first difficulty may be averted by using the arc at a sufficient distance from the screen to give a proper working distance, say, 3 or 4 ft. between the screen and the standard. In the tests by the committee of the National Electric Light Association already quoted, the color trouble was dealt with by observing the screen through a rapidly rotating disk having narrow radial slits. This in effect cut down the brilliancy of the screen to a point where color perception was considerably weakened. It is rather doubtful whether this procedure affected the standard and the arc in equal ratios.

In arc photometry still another troublesome factor is met in the tendency of the arc to wander from side to side of the carbon or to slowly rotate, so that the real luminous intensity is very difficult to catch. In the research just mentioned this was escaped by using a pair of mirrors simultaneously reflecting light from two sides of the arc lamp diametrically opposite, upon the photometer screen, the direct radiation being screened off. The line joining these mirrors was, of course, perpendicular to the line of the photometer bar, and the absorption of the mirror surfaces could readily be allowed for.

"Touching the Blooming Button."

The British Admiralty is much interested in the working of the Personnel bill in the American Navy, with the view of the possible amalgamation of the line and engineer officers of the British service. Mr. Arnold-Forster, secretary to the Admiralty, recently requested special reports on this matter, and Vice-Admiral Fitzgerald writes to the *London Times* on the same topic. The Admiral's letter is a spirited defence of the navy against many recent criticisms. But he admits that the line officers must wake up and become expert mechanics as well as good seamen, in order to master the complicated machinery of the fighting ships, or else the engineers will oust them from their present predominant position. "I am not prepared," he says, "to advocate the amalgamation of the engineers and executives, in imitation of the Americans. We are certainly not ripe for it yet. Moreover, it is just as well to wait and see how it turns out with them. But if an amalgamation is to be eventually avoided it can only be by our executives becoming practical mechanics. All real work is now done by steam, electricity and hydraulics. 'Touch the blooming button,' as Jack says, 'and let her go up.' I doubt not that he who is the most expert in touching the 'blooming button' at the right moment will be the victor in future naval battles, just as the best sailors won of yore."

Meeting of the American Institute of Electrical Engineers.

The subject for the New York meeting of the A. I. E. E. on Oct. 25 was the "Regulation in Prime Movers and Successful Operation of Alternators," with an introduction by President Steinmetz. The following papers were presented: "Angular Variation in Steam Engines," by Mr. P. O. Keilholtz, of Baltimore; "Parallel Operation of Engine-Driven Alternators," by Mr. W. L. R. Emmet, of Schenectady; "Parallel Running of Alternators," by Mr. Ernst J. Berg, of Schenectady; "Angular Velocity in Steam Engines, in Relation to Paralleling of Alternators," by Mr. Walter I. Shlicter, of Schenectady. A number of engineers prominent in the steam engine, gas engine and turbine field were also present, and participated in the discussion, with Messrs. C. F. Scott, of Pittsburg; Dr. A. V. Garratt, of Boston; Messrs. R. T. Lozier, R. D. Mershon and C. O. Mailloux, of New York. The meeting was very well attended, about 175 being present.

The five papers read at the meeting related more or less directly to the parallel running of alternators. In a paper introducing the subject, President Steinmetz dealt with the general considerations relating to the speed regulation of prime movers and the parallel operation of alternators.

In considering the effect of speed regulation of prime movers on the parallel operation of alternators therefrom, Mr. Steinmetz said that three principal factors enter as follows:

1. The permanent variation of speed, due to a change of load. 2. The temporary change of speed, due to a sudden change of load. 3. The periodic change of speed during each revolution.

1. With a change of load on the alternator, the power supplied to the prime mover must be changed correspondingly. This is done by a regulating mechanism which is based either on the speed (speed governor) or the acceleration (inertia governor). The speed of the prime mover is a function of the load, usually decreasing more or less with the increase of load. Since, however, alternators in parallel operation, and thus the prime movers driving them, must run in synchronism with each other, it follows that the division of load between alternators driven by independent prime movers depends on the division of power between the prime movers at (electrical) inequality of speed, but not upon the characteristics of the alternator. Thus it cannot be changed by a change of excitation of the alternator, etc., but only by reacting upon the governor (or by a change of belt tension with alternators belted to the same shaft). Therefore, for parallel operation of alternators a certain drop in speed with increase of load is necessary, and with a governing mechanism maintaining absolutely constant speed at all loads, the division of load becomes indefinite and parallel operation ceases to be feasible. If the drop of speed with increase of load is not uniform, but the speed almost constant for moderate load, alternators may operate satisfactorily in parallel at load, but see-saw at light load.

2. With a sudden change of load, since time is required for the governor to act and for the flow of power to the prime mover to change to the condition corresponding to the changed load, a temporary change of speed occurs, larger than corresponds to the change of load, and to reduce this variation of speed, storage of energy by the momentum of the flywheel is necessary. With the steam engine the momentum of the steam as expansive fluid is usually negligible in its effect, and the temporary effect of speed depends mainly upon the rapidity of the action of the governor. With water power, frequently the momentum of the moving mass of water predominates as a cause of the speed fluctuation with sudden change of load, and the speed fluctuation thus depends upon the momentum of the total moving mass of water. Stand pipes, relief valves and deflecting nozzles, represent means to reduce or eliminate the effect of the momentum of the moving water column upon the regulation of speed at sudden change of load.

3. Most rotary prime movers, as waterwheel, steam turbine, etc., give a uniform supply of power, and thus uniform speed during the revolution. Others, however, as reciprocating prime movers, steam and gas engines supply the energy by a number of impulses, and the torque, and, therefore, speed of the prime mover thus periodically varies during the revolution. The resultant torque of these prime movers consists of the pulsating torque of the energy supply (indicator diagram), the alternating torque of acceleration and retardation of the reciprocating masses, the alternating torque due to the finite length of the connecting rod, with vertical engines, the alternating torque of gravity in the ascent and descent of the reciprocating masses, and in gas engines also the pulsating negative torque of the compressor. The speed variation resulting herefrom can be reduced by such a design of the prime mover that the different components of torque superimpose upon each other to a more nearly uniform torque, or by the ues of a heavy flywheel. The most objectionable result of this periodic variation of speed is, however, the hunting of alternators and synchronous apparatus (as motors and converters), and this tendency to hunting seems to be aggravated by the use of heavy flywheels on the prime mover.

Electrical motors, as a rule, are not considered as prime movers, although no reason appears for making a distinction between the supply of power through a hydraulic pipe line or through an electric transmission line. With electric motors the rate of rotation is uniform and the periodic variation of speed thus absent, and due to the practical absence of a time lag the temporary variation of speed at a sudden change of load absent also, constancy of the supply voltage assumed. With continuous current shunt motors a cumulative series field may be necessary for parallel operation of alternators to secure the necessary drop of speed with increase of load. With induction motors, while the drop of speed under load may be considerably less than required for good parallel operation of engine-driven alternators, the speed variation with the load is so uniform that no difficulties are met.

In parallel operation of alternators driven by synchronous motors, due to the absolute constancy of speed under load, an entirely different set of phenomena occurs, similar in some respects to the parallel operation of rigidly connected alternators, but differing therefrom due to the flexibility of the synchronous motors in their relative phases, but rigidity in frequency. Difficulties with parallel operation of alternators driven from separate prime movers may be due to:

1. Lack of synchronizing power, arising from excessive armature reaction. This is practically unknown with modern alternators, in which the synchronizing power is always far in excess of the requirements of keeping them in step.

2. Surging or hunting between the alternators. In this case, forced surging and cumulative or resonating surging may be distinguished. With prime movers giving a periodic variation of speed during the revolution, periodically varying cross-currents flow between the alternators and between alternators and synchronous motors, in extreme cases even between alternator and induction motor, of an amplitude depending upon the amplitude of the speed variation. Under certain conditions this surging becomes cumulative, gradually increasing in amplitude so that the machines may break out of synchronism. The cause of this cumulative effect may be found in the electrical circuit in certain relations between the momentum of the moving mass and the electric constants of the circuit, or it can be found in the mechanical construction of the prime movers, foremost their governors. When due to the former cause it can occur also with turbine-driven prime movers and synchronous motors, while the mechanical hunting of the governing device, which is the more frequent and serious phenomenon, is most frequently found in direct-connected engine-driven plants.

The cumulative hunting is overcome by eliminating its cause, that is, breaking the resonance condition of the electric circuit by interference, or by changing its constants and damping the governor so as to stop its ability to hunt, or by reducing the amplitude of the hunting by a damping device in the electric circuit, usually in the field of alternators or other synchronous apparatus.

Mr. W. L. R. Emmet, in a paper on "Parallel Operation of Engine Driven Alternators," referred to the trouble met with in early alternating experience in operating engine-driven alternators in parallel. After referring to some remedies that had been proposed for the problem, and giving some of his own observations on the difficulties that had presented themselves, he described a solution which he had found very effective, and which consists in deadening the motions of the governor occasioned by engine oscillations, and at the same time leaving the governor free to move when actual changes of load came upon the machine. The device whereby this object was accomplished, and which Mr. Emmet perfected with the aid of Mr. H. W. Buck and Mr. Harte Cook, is shown in the accompanying illustration.

The main piston rod shown in this sketch is connected to the governor weights in such a manner as to be moved directly by them. The space on both sides of the piston and all the port spaces are filled with a heavy grease. By-passes *F*, are provided, through which this grease can flow from one side of the piston to the other. Each of these by-passes is actuated by a small piston valve *C*, backed by a spring *G*, and provided with a small by-pass *B*.

The practical effect of this device is that the springs tend always to

keep the gates of the main by-passes closed, and that the piston is thus virtually locked until the pressue at one end of it has forced the by-pass valve back. The first motion of the main piston is thus limited by the size of the small by-pass *B*, whereas its later motion, after the valve has been forced back, is limited only by the size of the main by-pass *F*. It will be readily seen that this dash spot can be so adjusted that it will act as a temporary lock on the governor mechanism, and that it will release entirely after the tendency to govern has continued for a certain length of time.

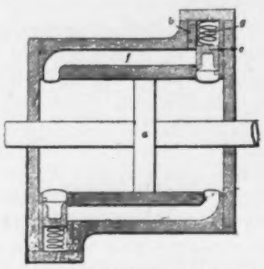


FIG. 1.—SECTION OF DASH-POT.

Such dash-pots were first applied to the engines in the plant of the Boston Electric Light Company, and it was found that they afforded a positive and complete cure of the oscillating troubles which had been experienced there. By their use, with proper adjustment, the engines can be operated under all conditions of load, and with any number in parallel, without the slightest indication of the oscillating trouble which was at first so difficult to prevent. In this case the tendency to oscillation was much more positive than in any other which has come to his notice, and the perfect success of the remedy has led him to believe that the method is universally applicable, and that all similar troubles can be cured by its intelligent application.

In order that this form of dash-pot may properly accomplish its functions in the most difficult cases, it must be made strong enough mechanically and hydrostatically to bear for a time, the entire force imposed by the governor weights in their effort to assume a new position, and the period of such opposition must be such that the dash-pot will not unlock within the time of a single period of oscillation when the machines are operating in parallel. It is also necessary that the dash-pot be kept full of grease, so that there will be no lost motion through air spaces. If the dash-pot falls short in any of these particulars, the remedy which it affords will only be partial, and in difficult cases it may prove inadequate. It is only in certain difficult cases that we need use such complete preventives as were found necessary in Boston.

Mr. Emmet briefly touched upon a few other facts which have developed in the course of his experience in the parallel operation of alternators. It is popularly supposed that it is necessary to use very heavy flywheels, in order that alternators may be successfully operated in parallel, it being the custom of some engineers to consider a guarantee of small angular variation as the equivalent to a guarantee for parallel operation. Mr. Emmet's experience has rather indicated that generators with light flywheels are most easy to operate in parallel. The frequency of natural oscillations in such machines is high, and the conditions of engine operation are generally unfavorable to their development. Large flywheels are desirable on direct coupled alternators because a steady frequency is a valuable feature in any system. The requirements of parallel operation, however, are rather unfavorable than otherwise to the use of heavy flywheels.

The peculiar periodic action of an engine's governor is not confined entirely to the parallel operation of alternators, but also may occur and cause trouble where a single alternator is operating a load of synchronous apparatus. We may even have alternators which will operate together in parallel, but which will, through periodic action of the governors, give trouble with certain loads of synchronous apparatus. It is thus desirable in all cases to prevent this periodic action of the governors, and by this prevention many troublesome difficulties may be lessened or overcome.

The behavior of all parts of the system while this oscillating trouble occurred in parallel operation was very beautifully illustrated during some experiments at Philadelphia. The shafts of engines were in line, and the relative positions of poles could, at all times, be seen; the poles of one machine appearing to stand still when the machines were in perfect synchronism. The movements of the governor mechanism could also be seen by oscillations of a lever arm which was in the line of vision. Ammeters and voltmeters were also placed in the same line. It was possible at a glance to see the degree of angular displacement of the poles, the degree of motion of the governor, and the fluctuations of the current and voltage. An observation of these conditions showed very clearly the exact character of this phenomenon. It was found that under some conditions the oscillation was an extremely sensitive matter, and had very little power of sustaining itself. A slight change in the field strength of one of the machines would sometimes break it up so that it entirely disappeared, after which the machines might remain steady for some time and then gradually begin to swing again. Under other conditions it was more persistent. Everything indicated, however, that it could not exist for any appreciable period without the actuating force afforded by the irregularity of steam impulses.

In a paper entitled, "Parallel Running of Alternators," Mr. Ernst J. Berg gives an analytical discussion of the principles governing the parallel operation of alternators driven by steam engines or turbines. One of the conclusions is that two machines of the same induced e. m. f. and armature reaction running in phase will share the load evenly. If one has twice as high armature reaction as the other, it will take one-half of the load, etc. Thus since machines of identical regulation have practically armature reactions inversely proportional to their size, it is possible to run such machines from the same engines at a proper share of the total load. Should, however, two machines of the same size and different armature reaction run from the same engine, the distribution of power will not be in accordance with the rating.

To balance the load it is then necessary to add reactance in one armature or to mechanically offset one armature in regard to the other, or, finally, to run them at such field excitation as will cause considerable cross-current, which effect will be discussed later.

In the analytical discussion it was assumed that the machines were running strictly in phase, which would practically limit the case to alternators clutched together. If, however, they are rigidly connected together, but out of phase, the current which is due to the resultant of the two e. m. f.'s has different phase displacement from the e. m. f. of one machine as from that of the other, that is, the energy corresponding is different in the two machines, or the one supplies more power than the other.

The relation of currents to e. m. f.'s can also be changed by changing the excitation. Assume machines of the same armature reaction which, before being thrown in parallel, have unequal e. m. f.'s. After being connected together their terminal voltages must be the same, therefore a cross-current must flow between them which, in the higher excited alternator, is lagging, and in the other leading; which currents, in conjunction with the field excitation, give a resultant field of same magnitude in the two, but displaced in phase. In the higher excited machine it will bring the resultant field more in phase with the energy current, thus giving a result equivalent to an armature of lower reactance; in the lower excited machine a result same as higher armature reaction. It is, therefore, possible to change the load by change of field excitation by sacrifice of current, since this method involves wattless currents between the generators.

It is thus evident that the question of distribution of power between alternators is quite simple, if they are running at absolutely the same speed at all loads; that is, if the engines regulate so closely as to permit the clutch to be opened and the armatures still retain the same positions. In reality, however, engines cannot be made to govern so closely, but one will tend to hold up the speed somewhat better than the other. That being the case, it is safe to say that, as a rule, the engines will not tend to give the same power at exactly the same speed.

With the same armature reaction and induced e. m. f., if different power is given each machine, the armatures must be offset a certain and fixed degree, which means that by even the most minute difference in speed regulation the armatures are forced to change their relative positions, which obviously is a cause for "hunting."

The relative power given by each machine depends upon the respective powers of the engines at identical speeds. The analytical discussion shows that a definite tendency for "hunting" exists, and that this hunting is manifest in a mechanical pulsation in the speed of the armatures, and a transfer of power from one unit to another.

A most superficial investigation will show that this flow of power is much greater than that corresponding to the stored energy of the armature flywheel, etc., at the relatively small differences in speed, and that pulsating power actually has to be supplied by the engines. Therefore, and since power cannot be obtained from an engine without corresponding steam, the flow of steam must be periodic to sustain an accumulated hunting.

The remedy is, therefore, to be found by preventing such periodic flow of steam, which can be accomplished by proper dash-pot arrangements at the governor. Other remedies also suggest themselves, the favorite being to make a short-circuited winding in and around the field of alternators. The object of such winding obviously is to establish a load when these oscillations occur, which load tends to stop

the acceleration and retardation of the armature. The disadvantages of this method are that losses of no small magnitude not only are introduced when the machines hunt, but also when they are running at steady speed, which losses are caused by induced currents in this short-circuited winding, due to pulsations of flux incidental to modern construction of iron-clad armatures.

Mr. Walter I. Slichter in a paper entitled, "Angular Velocity in Steam Engines in Relation to Paralleling of Alternators," dealt more particularly with the function of the governor of an engine in cases when an engine is direct connected to an alternating-current generator.

It was pointed out that when an engine is direct connected to an alternating-current generator, there are peculiar variations in tangential effort on the crank, and a consequent variation in speed of the shaft and flywheel. The angular velocity of the flywheel varies in two entirely different ways, due to two different causes. The first and best known is that due to a change of load; then the average velocity changes, and there is a change in the number of revolutions per minute.

The second effect is due to irregularities in the applied force and transmission of that force, and consists in a variation of the instantaneous value of the angular velocity, while the average value and the revolutions per minute remain the same and constant.

The first is altogether a function of the governor of the engine. The latter phenomenon, which is the one discussed by Mr. Slichter, is more complicated both in its causes and effects, as it introduces the distribution of the steam pressure in the cylinder, inertia of reciprocating parts, angularity of connecting rod and moment of flywheel. It is of importance where two or more alternators are to be run in parallel, or where synchronous motors are to be run from one or more alternators. Such machines tend to run in exact synchronism, and their inertia gives them a tendency to run at constant angular velocity. If now an irregular pulsation is impressed upon the system by the steam engine, there is a continual effort in each machine to keep in exact step with this pulsation, which causes an exchange of cross-currents and a liability of falling out of step.

When two alternators are running in parallel, if they differ in angular position even if revolving at the same speed, a cross-current will flow between them, tending to pull them together. This cross-current may be wattless, but even then it consumes some energy in the form of $I^2 r$.

The paper then assumes the case of a cross-current limited to 10 per cent of the full load of one generator, and the angular displacement allowable is calculated and found to be 2.3 degs.

The cause of the irregular effect is ascribed to the fact that the pressure of the steam on the piston due to cut off and expansion is uneven, being great during the first part of stroke, and small and even negative, due to compression, at the end. In the vertical engine the weight of the piston, rod, cross-head and part of connecting rod have to be lifted on the up-stroke, but are additive to the steam pressure on the down stroke. This makes a difference in the power of each stroke, raises the peak of one and increases unbalanced energy.

This pressure is transferred to the crank-pin through a varying angle so the effort is roughly equal to $P \sin \phi$, varying between zero at beginning and end of stroke and P at middle. Thus there is a combination of maximum values at the point of cut-off, as that comes near the middle of the stroke, and we get quite a pointed peak here.

The angularity of the connecting rod has a different effect in the forward and backward strokes, as in the forward stroke during the early part while the pressure is high anyway, it increases the effect of that pressure on the crank pin, and in the latter part it diminishes that effect. On the return stroke it has the reverse effect, diminishing in the early part and increasing in the latter. So that the final effect is to increase the peak of one impulse and diminish the peak of the other.

The inertia of reciprocating parts absorbs energy at the beginning of the stroke, and gives it up at the end, so it has a beneficial effect on the diagram, smoothing the peak and raising the low values. The combination of two or more cylinders on the shaft naturally tends to even the effort and also to diminish the length of time one impulse lasts, thus diminishing its effect.

Combining the effort of three cylinders would seem to give a more even torque than two cylinders, but the actual diagrammatic combination shows there is very little choice between a two cylinder or three-cylinder engine.

In a single cylinder, double-acting engine there are two impulses per revolution, and in a cross-compound engine there are four impulses. Each impulse is more or less like any other. By analyzing the variation in speed during one impulse we can derive our conclusions. Though as all the impulses are not equal, it is as well to select that impulse having the greatest amount of unbalanced energy so as to know the worst conditions.

During the first quarter of impulse, the effort is less than average, during the second and third quarter (approximately) the effort is greater, and during the last quarter it is low again. The unbalanced effort represents a force which, acting on the mass of the flywheel, produces an acceleration, $a = f/m$. Thus by referring the torque diagram (Fig. 2) to the line of average torque as base, we get a curve of acceleration.

Integrating this acceleration, we get a curve of velocity v. This curve lags 90 degs. behind the acceleration curve. Thus starting from a point of minimum torque a, the acceleration will be negative. From a to b the torque is less than average, the acceleration negative, the speed will keep dropping in value until b is reached, where, since the acceleration changes sign, v is a minimum, and commences to increase again; v will keep on increasing as long as the acceleration is positive, or to d, where v has its maximum value.

If we assume the variation is sinusoidal, then the average value of v from a to c is v_1, and of s, the percentage variation in speed, is $2\,s/\pi$.

The speed is low from a to c, or while the crank is passing 0° deg. of the crank circle; during this time the crank continually falls behind the position it would maintain at constant angular velocity, and

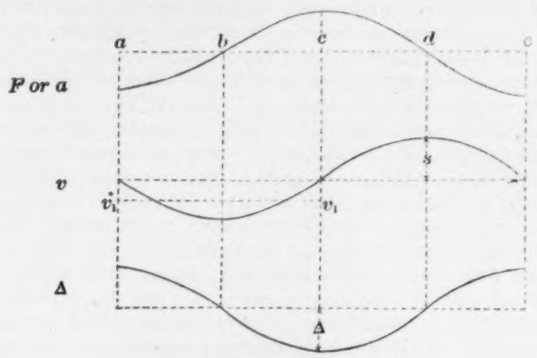


FIG. 2.—TORQUE DIAGRAM.

at C the maximum displacement occurs, for there the speed again becomes greater than average.

The paper then proceeds to an analytical investigation of the various factors influencing speed variation, which in part duplicates portions of the Keilholtz paper. The results are applied to the data of an actual engine.

A paper by Mr. P. O. Keilholtz entitled, "Angular Variation in Steam Engines," gives the result in analytical, tabular and graphic form of an investigation undertaken with a view to determining the angular variation of a cross-compound vertical engine of a certain type, direct-connected to a 500-volt railway generator. The manner of conducting the test is described, an analytical investigation is given of the factors entering, and the results are given in the form of tables and of curves.

An artificial load was put upon the generator by means of a water rheostat consisting of iron plates immersed in a dock, whereby a constant load of 1440 amperes at 562 volts was maintained. Simultaneous readings were made of the current and e. m. f.'s, and at the same time indicator diagrams were taken and a record by means of a tuning fork which registered the angular variation in speed.

The tuning fork was driven by a storage battery, the usual make-and-brake device being employed. Manila paper was secured to the face of the flywheel engine by shellac varnish applied at the edges, then slightly moistened. Upon drying a smooth surface was obtained upon which to take the tuning fork record. A paint was applied to the paper so as to enable the record to be taken with phosphor bronze points on the tuning fork. With the tuning fork at rest and the wheel revolving, the record consisted of a circle. With the tuning fork in operation this line was crossed at three points during each complete vibration of the tuning fork, and the measurement of the distances thus cut off gave the data for determining the variation of the engine speed.

In calculating the turning effort, the flywheel rim and spokes, the crank disk and armature were reduced to the crank center and the

indicated effort at the crank pin was corrected for accelerating and returning forces introduced by these and the connecting rod, the radii of gyration in each case having been determined for this purpose.

Modern Electric Light Accounting.

IN a paper with the above title read at the recent Buffalo meeting of the Association of Edison Illuminating Companies, Mr. A. S. Knight described the accounting system of the Boston Edison Company.

Mr. Knight first reviewed the conditions which establish the accounts of a manufacturing corporation. The money paid into a corporation by its stockholders is invested by the officers in the plant of the company. This fact necessitates several accounts; first, the credit to the stockholders (or the capital stock account) for the money paid in, and the charge of the same money first to the cash account, then to the plant account, or as it may be called, the installation and property account. The capital stock and the installation and property accounts are termed the permanent accounts, the transactions entering into these accounts possessing a finality not participated in by any of the later accounts. Part of the stockholders' money must, at least at first, be utilized as a working capital, thus necessitating upon the ledger a set of accounts which are termed miscellaneous or cash assets. The principal accounts of this character are the already mentioned cash account, a merchandise account, and the consumers' accounts, or the accounts receivable. He said:

If the stockholders have not paid in sufficient money to start the business, money must be raised in some other manner, usually by bonds issued by the stockholders, which are commonly considered a part of the permanent debt, although they are really a temporary obligation (often for a long term of years) of the stockholders to the bondholders, the title to the plant always remaining with the stockholders so long as the bond interest is paid. Still more temporary liabilities (the floating debt) are created by the buying of supplies or the borrowing of money on the company's notes, the principal accounts necessitated being accounts payable and notes payable.

The operation of the plant creates a new set of accounts, the first of which is the operating account against which are charged all supplies and labor used in the manufacturing process, excepting such as are required to remedy the wear and tear on the plant, the expenditures for the latter being charged to repair and renewal. These accounts are, of course, offset by the earnings account, which should be credited with the bills rendered the customers as fast as they are sent out, and these accounts, together with a few others such as the interest account, dividend account (the latter being charged with all money paid back to the stockholders out of the company's net earnings), constitute what are known as the profit and loss accounts, inasmuch as they are all closed at the end of each year into a profit and loss account.

By arranging the accounts on the monthly balance sheet into the groups mentioned above, as shown in Table I., we are enabled to consolidate the company's standing and condition into a very few totals, such as may be easily impressed upon the mind at any time it may be desired.

It has been found a great advantage to separate, upon the general ledger, the installation and property account into the completed plant and that which is under construction, calling the latter the unfinished installation account. The details may be kept as fine as desired in the latter account and transferred in bulk when the work is completed, thus affording a much better opportunity for ascertaining later the cost of any particular work, than if the charges are jumbled into the installation account haphazard merely in the order in which they happen to be paid. Before commencing any installation work an appropriation for doing it is opened, based upon the estimated cost of the work. Each appropriation covers a certain piece of work, say, installing an engine and dynamo, or laying a new feeder, and all orders for installation work must be drawn against their proper appropriations and entered under them in the appropriation book, specifying for what the orders are drawn. Estimates, of course, are entered against the orders, and as soon as the totals of these equal the amount of the appropriations no more orders will be approved without an increase in the appropriation. Costs are shown against each particular order when completed, the totals of which must not overrun the appropriation, or somebody will be asked to explain. The idea of the appropriation is twofold, first, to summarize the cost of doing work into intelligible groups, and, second, to know at all times what we are doing and how we stand in this important branch of our business. We believe also in the importance of impressing upon our people the amount of money they are spending and carry this idea into the operating field where every order drawn must bear an estimate of cost before being approved, variations of 10 per cent either way between the cost and the estimate requiring special approval.

The merchandise account should, of course, be kept at cost prices and goods credited as nearly as possible at the prices at which they are charged. By this means when inventories are taken of merchandise on hand, the totals should agree with the amount called for by the books. It is to be hoped there is no electric lighting company at the present day which depends upon the system, still common in ordinary mercantile business, of taking an inventory to determine its profit; such a system in our business is absolutely inexcusable with the present simple methods of ascertaining earnings and expenses monthly. This is referred to since the modern system of accounting depends upon the pricing and charging at cost of all requisitions for material used.

It has been found very useful to have an additional account in which to group the many miscellaneous transactions that are bound to come up. This is called on the general ledger, "Sundry Open Accounts," and it contains the minor accounts which would ordinarily require a special ledger account. Most of the accounts opened upon this ledger are of a temporary nature, or their ultimate disposition has not been decided upon. All payments on account, unless for new construction (which would go into the unfinished installation account) are charged this account and held there until the final bill is approved, when this account is credited and the final account charged. This is also utilized to even up the different months' expenses, by taking care of payments made only once a year, a proportion being charged into each month's expenses and credited sundry open accounts, against which the bill is charged when paid, thus balancing the account. A balance sheet is, of course, taken off of the sundry open accounts every month.

No details of the accounts payable have been kept for several years. That is, the general ledger not only does not show the parties from whom they buy goods, but they keep no sub-ledger showing the accounts with these parties. With a properly planned voucher system, some form of which all companies should adopt, it is possible to keep track of this information directly from the register of disbursements, by merely noting in the latter the dates when vouchers are paid and taking a trial balance off this book each month. After the first month the previous month's trial balance is utilized and any

TABLE I.

GENERAL LEDGER ACCOUNTS.

The following comprises all the accounts carried on the General Ledger and the arrangement shown is that of the Monthly Balance Sheet.

DEBIT ACCOUNTS.	CREDIT ACCOUNTS.
PERMANENT INVESTMENT.	PERMANENT DEBT.
A. Installation and Property.	AA. Capital Stock.
B.	BB. Installments on New York.
C. Liverpool Wharf Estate.	CC. Trust Mortgage Bonds.
D. Unfinished Installation.	DD.
MISCELLANEOUS ASSETS.	FLOATING DEBT.
E. Cash.	EE.
F. Station.	FF.
G. Stock.	GG.
H. Notes Receivable.	HH. Notes Payable.
J. Accounts Receivable.	JJ. Accounts Payable.
K. Sundry Open (either Dr. or Cr. acct.)	
L.	LL. Taxes Accrued.
M.	MM. Legal Expense Accrued.
N.	NN. Unpaid Dividends.
PROFIT AND LOSS ACCOUNTS.	PROFIT AND LOSS ACCOUNTS.
O. Operating.	OO. Earnings.
R. Repair and Renewal.	RR.
T. Maintenance.	TT.
U. Dividends Declared.	UU. Discounts.
V. Interest (either Dr. or Cr. acct.)	VV.
W.	WW. Reserve for Maintenance.
X. Profit and Loss (either Dr. or Cr. acct.)	XX.

unpaid vouchers during the current month added, the whole balancing with the accounts payable ledger account.

OUTLINE OF CLASSIFICATION.

The ledger accounts as shown in Table I. are each represented by a letter which is always used when the account is sub-divided. In explaining this matter Mr. Knight quoted from his "Classification of Accounts," issued under date of July 1, 1900.

"Details of the Installation Property Account (A), Unfinished Installation Account (D), Stock (G), Operating (O) and Repair and Renewal (R) accounts are indicated by numbers following the letters shown, each account taking such of these numbers as are necessary for its divisions."

To facilitate memorizing, the numbers of the same sub-divisions in different ledger accounts are always the same. For example, A 23 is installation and property meter account, G 23 is the stock meter account, O 23 is the operating meter account, and R 23 is the repair and renewal meter acount, so that the employes of the meter department have only one number to remember and by making use of the initial letter of the operating and repair accounts, memorizing the classification is made as simple as possible, and mistakes are almost unknown. By referring to Table II. the details of these divisions and the numbers representing same will be found.

Quoting again from the Classification Book before referred to: "Some of the preceding divisions are further sub-divided, and these sub-divisions will be found in the following index tables. The numbers previously given when following the general ledger account letter, constitute the 'original numbers'; the sub-divisions shown in the following tables (which, however, I am unable to furnish with this paper for want of room) are to be indicated by 'additional numbers,' which in each case should follow the original number, a decimal point, or dash, separating the two.

"Attention is called to the fact that the location of a number with reference to the decimal point is of the greatest importance. * * * If it is not desired to use the figures intervening between the number used and the decimal point, ciphers should be put in their places in order that the number used may retain its proper position with relation to the decimal point. * * * It will be found that in the generating account three figures are necessary for the additional numbers; these have been apportioned so that the tenth (or first figure to the right of the decimal point) always indicates only the station number, the hundredth (or second figure) only labor or material, while the thousandth (or third figure) represents further sub-divisions if any are required. In the distribution accounts, inasmuch as no station numbers are needed, rather than retain the 'hundredth' to indicate labor or material, necessitating always a cipher between it and the decimal point, the cipher has been dropped so that the tenth there represents labor or material, and the hundredth the additional sub-division. In classifying bear in mind that 'labor' is intended to cover only that upon the company's pay rolls, 'material' covering everything else, including even any labor which may be furnished and billed by outside parties."

To make this system clearer, the following illustration is given: As will be seen by referring to the sub-division in Appendix B, account O 41 is the operating fuel account. In this account all three of the figures in the additional number are made use of, the first figure representing the station number where the fuel was consumed, the second whether the charge was for (1) labor, or (3) material, and the third figure whether it was for (1) soft coal, (2) hard coal, (4) carting coal, (5) carting ashes, or (9) miscellaneous. Therefore, a charge marked O 41.331 would go against operating fuel at third station, the second decimal figure (3) would show it was material, and the third figure (1) would indicate soft coal. Also O 41.115 would mean operating fuel account, first station labor carting ashes.

It will be seen that the use of these numbers gives a tremendous opportunity for sub-divisions so that practically any desired extensions can be made at any time, while absolutely no disturbance is created if it is decided to drop some of the finer sub-divisions, in fact, any of the accounts could be at any time stripped down to the ledger letter if desired.

During the last three or four years a systematic classification of earnings has been kept in greater detail than is customary in most companies. Several different kinds of contracts were closed with customers, and it was considered important to know the results of each of these different classes. In addition to the customary classification into incandescent, arc, power, etc., the contracts were separated into half a dozen classes under each of these divisions, viz., (1) commercial rates (or the non-contract customers), (2) long use contracts (additional discount for average use of connected load), (3) fixed discount contracts, (4) fixed amount contracts, (5) special contracts and (6) maximum demand contracts. This has proved of great value, as a monthly report shows, for each class, the number of customers, kilowatts connected (or maximum demand in the case of Class 6) kilowatt-hours sold, and net income; from this information is derived, and shown on the same report, the average hours' use per day, the average income per kilowatt-hour, and the total income per day per kilowatt connected.

The effort of any accounting officer must always be directed to keeping down the clerical expenses inasmuch as this is in one sense unproductive labor. The principal thing to prevent is a duplication of work, and this in Boston has been accomplished as completely as is possible with due regard to verification and proving of accounts.

As indicated above, practically all the sub-ledgers (excepting for accounts receivable), and all abstracts of shipments from stock, such as are ordinarily kept by large corporations, have been done away with. There has been adopted instead a standard form called the "Disbursement Sheet," a reduced sample of which is shown herewith. One sheet is provided for the smallest sub-division of each account and filed in its proper numerical place, additional sheets, of course,

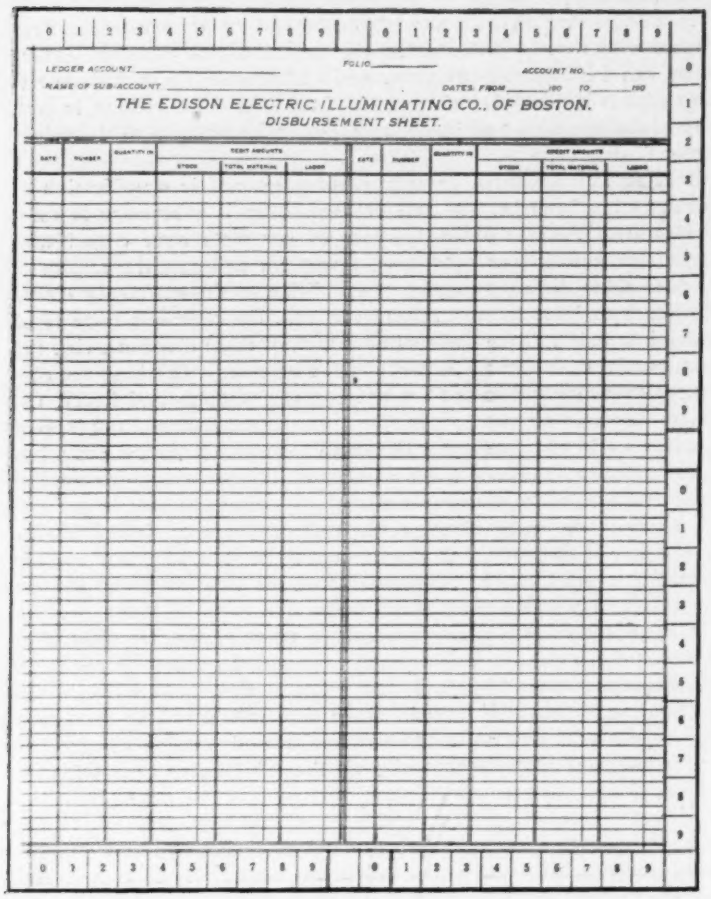
TABLE II.

SUB-DIVISION OF ACCOUNTS WITH "ORIGINAL" NUMBERS.

GENERAL EXPENSE ACCOUNTS.			SYSTEM OF DISTRIBUTION ACCOUNTS.			GENERATING ACCOUNTS.		
Ledger Accounts.	Original Numbers.	Names.	Ledger Accounts.	Original Numbers.	Names.	Ledger Accounts.	Original Numbers.	Names.
OFFICE EXPENSES.			O.	20.	Distributing Dept. Exp.	O.	40.	Generating Dept. Exp.
O.	1.	Officers' Salaries.	A. D. G. O.	21.	Incandescent Lamps.	O.	41.	Fuel.
O.	2.	Office Pay Rolls.	A. D. G. O. R.	22.	Arc Lamps.	O.	42.	Water.
O.	3.	Office Sundries.	A. D. G. O. R.	23.	Meters.	O.	43.	Oil and Waste.
O.	4.	Exploiting.	D. O. R.	24.	Buildings Wired.	O.	44.	Labor Boilers.
O.	5.	Legal Expenses.	A. D. G. O. R.	25.	Street Cond's.	O.	45.	Labor Engines.
O.	6.	Stationery, Printing and Postage.				O.	46.	Labor Electrical.
O.	7.	Insurance.				O.	47.	
O.	8.	Taxes.				O.	48.	Battery Supplies.
O.	9.	Rents.				O.	49.	Sundries.
O.	10.	Miscellaneous Expenses.						
TECHNICAL EXPENSES.						R.	52.	Station Building.
O.	11.					R.	53.	Mechanical Apparatus.
O.	12.	Supply Department Pay Rolls.						
O.	13.	Freight, Teaming, etc.				R.	54.	Boilers.
O.	14.	Boxing, etc.				R.	55.	Engines.
O.	15.	Building Sundries.				R.	56.	Dynamos.
O.	16.	Miscellaneous Stock Exp.				R.	57.	Electrical Apparatus.
O.	17.	Laboratory Exp.				R.	58.	Batteries.
O.	18.	Engineering Exp.				A. D.	61.	Real Estate.
						A. D.	62.	Station Building.
						A. D.	63.	Station Apparatus.

being inserted as fast as the first one is filled. Every invoice, requisition for material taken from stock, teaming ticket, petty cash ticket, or pay roll charge is entered directly on its proper sheet. In order that the sheets might be readily located a little system was designed of indexing around the edges of the sheet, which provides for indexing to six numerals. At the time the sheet is opened it has the unused numbers cut off, so that when it is put in its place it forms a part of as many flights of steps as there are figures used, and can be almost immediately picked out from among several hundred.

Weekly reports of the expenses are taken from the disbursement sheets on forms provided for the purpose and sent to the heads of departments interested, each department being furnished only with its own figures, the reports providing a comparison with the figures for


LEDGER ACCOUNT _____ FOLIO _____ ACCOUNT NO. _____

NAME OF SUB-ACCOUNT _____ DATES FROM _____ 190 TO _____ 190

THE EDISON ELECTRIC ILLUMINATING CO., OF BOSTON.

DISBURSEMENT SHEET.

DEBIT AMOUNTS | CREDIT AMOUNTS

DATE | NUMBER | QUANTITY IN | STOCK | TOTAL MATERIAL | LABOR

SAMPLE OF DISBURSEMENT SHEET.

the same account for the previous year. These weekly reports may perhaps be a refinement which, although desirable in a large company, might not be required by the smaller companies, but their omission would not at all interfere with the system, as monthly reports are also taken off and would answer the requirements of most of the companies.

Separate columns are provided on the disbursement sheets for the shipments from stock, and the footings of these columns are taken at the end of the month to form a transfer voucher which is entered upon the register of disbursements crediting stock and charging the proper accounts.

It will be noticed upon examining the sheet that it provides for showing the quantities of the articles charged up, and this is a great benefit which is taken advantage of wherever possible; for example, the number of carbons used, the pounds of coal burned, etc., are all entered upon the disbursement sheets, thus enabling all the required statistical data to be taken from this book. Being in loose leaf form, as many binders may be used as are needed, the limit being determined by convenience in handling.

For the encouragement of the smaller companies, Mr. Knight said that he had also tried this system in a small company and as far as it was adopted it was a perfect success.

A similar sheet is employed for the distribution of earnings. It is numerically indexed similar to the disbursement sheet, and the quantity consumed as well as the net amount of the bill is entered, thus enabling to be taken from these sheets all the data necessary, excepting the connected load, which is reported monthly by the contract clerk from his card catalogue of the different classes of contracts. The income sheets is the only place where the earnings are entered (excepting, of course, the customers' ledgers where only the net bills and dates of same are posted), as the old form of report of bills rendered or meter sheets have been done away with, and all the posting, etc., is from the customers' cards upon which the figuring is done. The income sheets are proved with the total amount of customers' bills, as shown by ledgers, the bank balance ledger form adopted nine years ago being used. Each ledger can be balanced separately with the income sheets and also with the station cash book in a loose leaf form, the collectors turning in the sheets which are filled out as they make their collections, and these sheets are consolidated with those showing the collections at the office and totals carried forward from sheet to sheet in the office.

The simplicity of this system from the treasurer's standpoint, who keeps the general books, will be seen when from the fact that he has but three journal entries to make each month, viz., (1) comprising the totals of the income sheets which is charged by him against accounts receivable and credited earnings and any other miscellaneous accounts interested, (2) the footings of the station cash book, which are charged by him to the station account and credited accounts receivable, and any miscellaneous accounts interested (the credit to the station account coming on his general cash book for the total amount deposited each month), and (3) the footings of the register of disbursements of which the principal credit is to accounts payable and the charges to the miscellaneous accounts interested.

National Reciprocity Convention.

A national convention for the discussion of commercial reciprocity will be held in Washington, D. C., beginning on Tuesday morning, Nov. 19, and continuing for three days. This convention will be composed exclusively of manufacturers properly accredited as delegates by trade and commercial organizations, and its deliberations will be confined to commercial reciprocity in its bearing upon the industries of this country and its influence upon our export trade. Those who desire to attend this convention and participate in its discussions should seek appointment as delegates from organizations with which they are allied, under the conditions set forth in a circular issued.

This convention is to be held in pursuance of action taken at the annual convention of the National Association of Manufacturers in Detroit in June, 1901, and subsequent action by the Executive Committee of that association. The committee of arrangements, appointed by the executive committee of the National Association of Manufacturers, met in Philadelphia at its offices and prepared a call, in part as follows, for the appointment of delegates to the convention:

"In pursuance of a suggestion advanced by the National Association of Manufacturers, at its annual convention in Detroit in June, 1901, and subsequent action by the executive committee of that association, arrangements have been made for the holding of a national Reciprocity Convention in Washington on Nov. 19. The sole purpose of this convention is to discuss the expediency and practicability of the broader application of the principle of commercal reciprocity as a means of expanding foreign markets for American products, without sacrificing the interests of any of our industries. The object of this convention is to ascertain accurately the views of representative manufacturers on this subject, and to formulate, if possible, some practical suggestion for such legislation or diplomatic negotiation as may be necessary to establish more intimate commercial relations between the United States and other nations."

President Search, chairman of the committee of arrangements, announces that as far as possible invitations to appoint delegates will be addressed direct to the various trade and commercial organizations of the country, but should any be overlooked through inadvertence or because of lack of information, it will be entirely in order for those thus omitted to address the committee of arrangements and to ask for instructions and credential blanks.

The co-operation of all organizations that embrace manufacturers within their membership is earnestly solicited in order to ensure the complete success of this effort to give definite form and expression to the views of the manufacturers of the United States on the subject of commercial reciprocity.

Electricity Building for the St. Louis Exposition.

The Electricity Building for the St. Louis Exposition of 1903 is the work of Walker & Kimball, of Boston and Omaha, who were chief architects of the Omaha Exposition. The structure is located on the main central avenue, and is one of the leading elements of the main Exposition picture. It will have a frontage toward the north

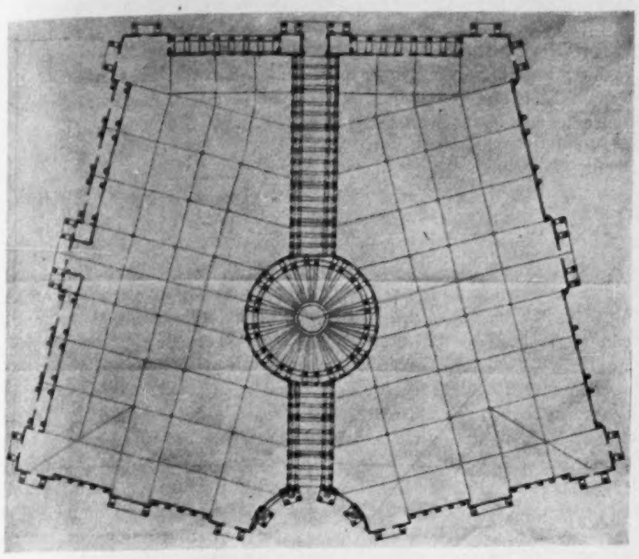


FIG. 1.—PLAN OF ELECTRICITY BUILDING.

of 650 ft., and toward the east of 525 ft., facing the main lagoon. The design is a bold columnated treatment of the Corinthian order. The columns are carried well down toward the ground, to give height to the facades.

The facades are well accentuated by elevated pediments and tower effects over the four main entrances and at the corners. Over the accentuated places, as well as over the twin columns, which form a pleasing variation of the treatment of the facades, opportunity for ample sculptural decoration is supplied.

The fenestration is bold and appropriate, giving ample light and substantial wall treatment. On two sides of the building are loggias which add pleasing effects of light and shadow. There are numerous openings on the facades, such as exhibitors always seek in selecting

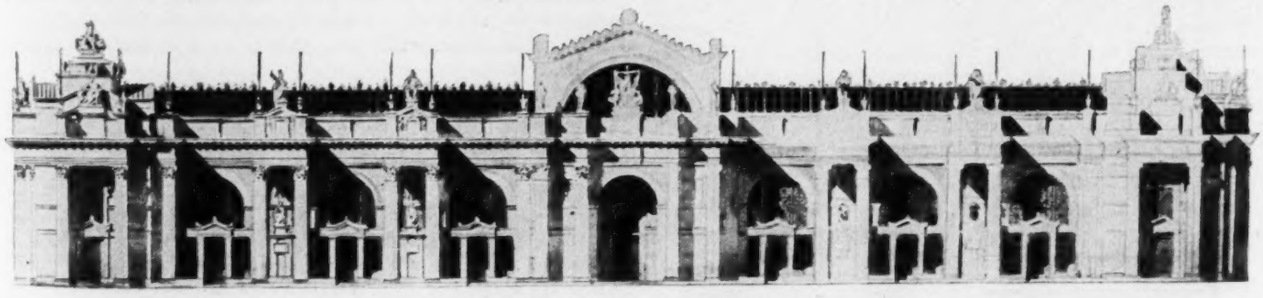


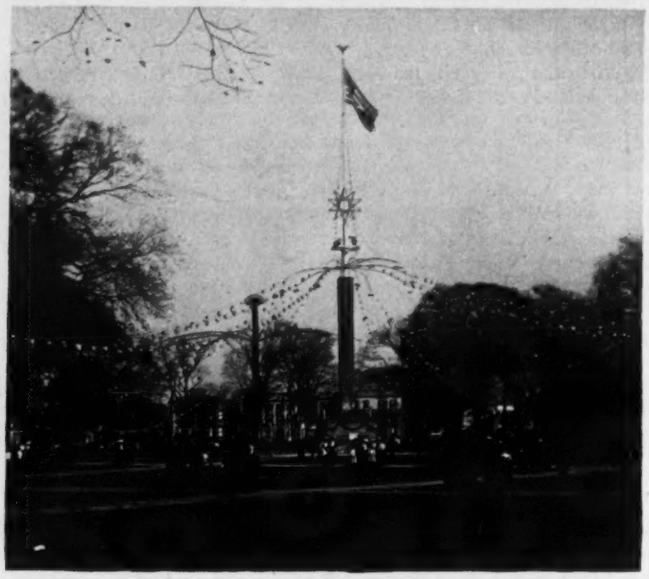
FIG. 2.—ELEVATION OF ELECTRICITY BUILDING.

their exhibit space. The plan of the building is simple and well treated, showing an effort to supply as much exhibit area as is possible with the 350,000 square feet of floor space. The exhibit space is compact and symmetrical. An extensive balcony sweeps around four sides of the building, supplying 100,000 square feet of additional exhibit space.

The Yale Bi-Centennial Exercises.

Yale University has just celebrated with great enthusiasm and eclat the two hundredth anniversary of its foundation, and New Haven was *en fete* during the whole of last week, when thousands of old Yale graduates and visitors thronged the beautiful City of Elms and joined in the various exercises appropriate to the occasion. A number of degrees were conferred, as noted editorially elsewhere in our pages.

It is needless to say that electric lighting and decorative effects formed a conspicuous feature of the Yale Bi-Centennial. Mr. Geo D. Foote, an electrical engineer of New Haven, prepared plans for the display. One chief feature was a liberty pole of electric lights, illustrated herewith. A big star surmounted the pole. From the pole there were festoons with tri-colored lights sweeping in curves from 240 to 420 ft. in length, centering in stars of lights at the old elm



YALE BI-CENTENNIAL ILLUMINATION EFFECT.

trees. There were also festoons of electric lights between the trees themselves. In these decorations it is stated that 4300 lights were required. The front of the City Hall was also outlined by electric lights, and elsewhere in this city electrical illuminations could be seen. The current for the work was obtained from the trolley system of the Fair Haven & Westfield Railway Company. The official contractor for the work was Mr. W. W. Gale.

New Telephone Patents.

Among last week's telephone patents was one covering the use of an arc lamp circuit as a telephone relay. In the latest issue of the Patent Office a patent is granted to Harry A. Rhodes, of Denver, Colo., on a telephone repeater involving the use of the phonograph. A record is made on the phonograph by a recording tool actuated by a solenoid, which takes the place of a receiver or repeating coil, and a tracing tool, impinging on the record transmits its motion by means of a multiplying lever to a microphone. The arrangement of coils and circuits to provide each line circuit with its respective recording and tracing apparatus at the repeating station is ingenious, but we fear that neither the arc lamp nor the phonograph will solve the telephone repeater problem.

An addition to the army of party-line selective bell systems is found in the invention of William W. Dean, of Chicago, to whom a patent has just been granted on a party-line system. As will be seen by the diagram the system is applicable to a four-station line, one plus and one minus bell on each leg of the metallic circuit, which, for signaling purposes, is adapted to be used as two distinct grounded circuits. Referring to the diagram, line 1 carries a plus bell at station C and a minus bell at station D, and line 2 carries a plus bell at sta-

tion A and a minus bell at Station B. The bells are permanently in series, and are shunted to telephonic currents by the non-inductive resistances a^3, b^3, c^3, d^3. It is clearly seen by the arrangement of ringing keys and generators that depression of key f^2 will connect positive current by the sleeve of the plug and spring e^1 of the jack, to line 2, and so ring plus bell at station A. In the same manner key f^3 will connect positive current by the tip of the plug to line 1, and so ring plus bell at station C. Similarly f^1 will ring bell at station B and f^4 that of station D.

When the receiver is taken off the hook at any station the ground connection is cut off and the telephone instruments are bridged across

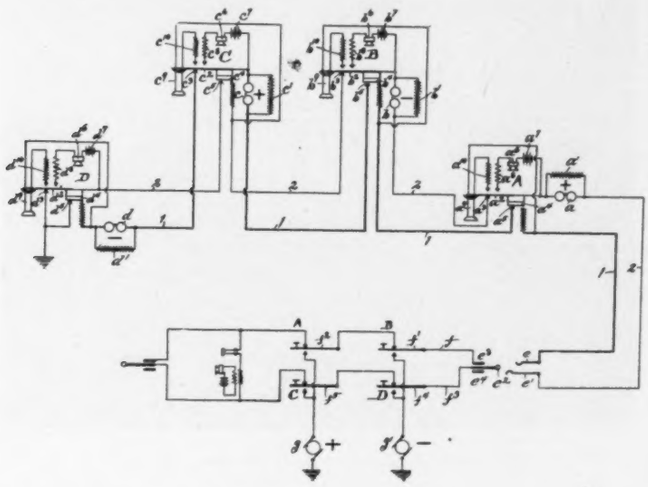
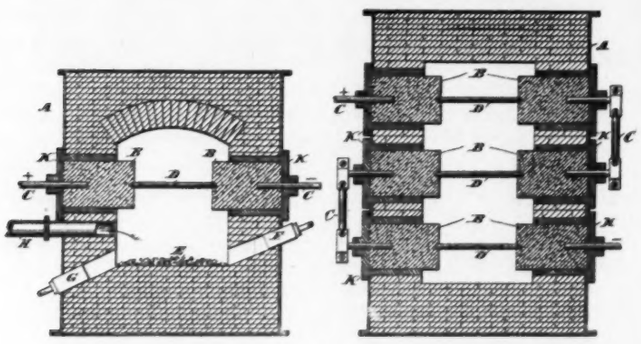


DIAGRAM OF DEAN SELECTIVE BELL SYSTEM.

the metallic circuit; in fact, as will be noticed by reference to the diagram at station A, removal of the receiver cuts off the line entirely beyond the station by the breaking of the line contacts at a^3 and a^5. This feature might be expected to cause some trouble in actual working.

Electric Furnace.

A very simple electric furnace, covered by patents issued Oct. 22, to William T. Gibbs, of Buckingham, P. Q., Canada, is illustrated herewith, Figs. 1 and 2 showing the construction in vertical and horizontal section, respectively. The heating chamber *A* is a built-up structure of firebrick or carbon blocks, formed with a reflecting dome, and provided with suitable charging and discharging openings *F*, *G*. The heating means comprises one or more carbon resistance rods *D*, clamped between carbon abutments *B*, which in turn fit into cast iron



FIGS. 1 AND 2.—ELECTRIC FURNACE.

sockets *K*, built into the walls of the furnace. Electrical connection is made through the conductors *C*, and in case volatile products are sought, these are withdrawn through the pipe *H*.

The distinctive feature of the furnace is the position of the heating resistance, out of contact with the charge under treatment, and immediatley beneath the reflecting dome. This general arrangement is similar to that adopted by Moissan for his earlier work on the chemistry of high temperatures, except that Moissan relied upon the arc as the source of heat. The furnace recalls, also, the early arrangement proposed by Bradley and Crocker in which a conductor is inserted in the top of the furnace chamber, the charge being heated, as in the present case, solely by radiation. But for general work the new furnace presents several clear points of advantage over prior forms, chief among which are the absence of the carbon dust and vapor which always emanate from the arc and which enter as a disturbing element into many reactions, the ready regulation of the temperature, and the adaptability of the furnace for currents of any character by connecting the resistance rods in series, as shown in Fig. 2.

Electric Street Railways for St. Petersburg, Russia.

For some little time past, it has been known that Mr. Murray A. Verner, of Pittsburg, Pa., who has been actively engaged in American electric railway enterprises for some years past, is endeavoring to change over the street railways of St. Petersburg to electricity. A special correspondent of the *New York Times*, under date of Oct. 15, writes in regard to this matter as follows:

The Municipal Council has been discussing the matter for several years, but Mr. Verner's offer is the first genuine step towards the introduction of electricity. The city owns three lines, and a number of other lines are owned and operated by two private companies. The city has begun legal proceedings against these companies, with a view of unifying all the surface traction companies. Mr. Verner's offer stipulates that the city shall turn the private lines over to him when the matter has been settled.

Mr. Verner's offer is regarded by the press as straightforward, businesslike and fair. It is too early to predict success, since many cooks help make a broth in this city, but the Municipal Council was not approached until Mr. Verner, who has been to St. Petersburg three times within 14 months, had carefully studied the whole problem from a financial and technical point of view, and, through his local representative, Mr. Heydecker, the American Vice Consul, had sounded various authorities about the matter. Mr. Verner's proposal is, briefly stated, to organize a company under the laws of Russia, with a capital stock of 50,000,000 rubles, and the right to issue bonds to the same amount. He states that he and his friends can supply the money. He would agree to complete the transformation of all existing lines into electrical lines within four years from the date of the franchise, and would so arrange the traffic that no needless change of cars would take place in going to and from the center of the city.

He would employ girder rails weighing 96 lbs. (English) to the lineal yard, except in the suburbs, where 80-lb. rails would be used. Overhead trolley wires would be employed, but the feed wire would be carried in conduits. Double-deck cars would be abolished and replaced by trains with three separate classes. The platform of the winter cars would be inclosed.

Bridges would be widened and strengthened where necessary at the company's expense, and the company offers to assume the burden of building a stone or steel bridge across the Neva near the palace, to replace the present wooden structure, the cost of the bridge to be deducted from the annual compensation payments. This is a point of great importance to the city, which is considering the issue of bonds for this purpose.

It is stipulated that Russian materials and Russian engineers and workmen shall be employed as far as available. The compensation clause stipulates the immediate payment by the company of the actual cash value of the inventory of the existing lines, the payment to the city during four years of the previous net revenue of the various lines, and the payement annually thereafter of a percentage of the gross receipts to be agreed upon by mutual consent.

The municipality shall enjoy the right of purchase at the end of 25 years, again after lapse of an equal period, and thereafter every 10 years. Bonds shall be paid for at par, and the net earning capacity of the shares shall be capitalized for purposes of purchase. The municipal lines have not been paying satisfactorily, owing, presumably, to increased cost of operation under municipal control. A decrease of about 50,000 rubles in the net revenue is anticipated for 1902.

Recent Figures of American Trade.

The United States continues at the head of the list of the world's exporting nations. The comparative figures prepared each month by the Treasury Bureau of Statistics, exhibiting the imports and exports of each of the principal countries of the world, and the average per month during a given period, show that the domestic exports from the United States are greater than those from any other country, and that the monthly average during the year 1901 has been higher than that of any other country. For the nine months ending with September, our exports of domestic products were $1,024,605,181, against $1,018,845,768 from the United Kingdom, the next largest exporter of domestic products in the same period. While a comparison during the same period with Germany, France, Russia, Netherlands and India, which follow in the order named in the magnitude of their exports, is impracticable, because their fiscal years are not conterminous with that of the United States, the totals of their exports during the latest available years show not only that the United States is clearly in the lead as an exporter, but that the growth in her exports has been more rapid than that of any other great exporting nation. In the calendar year, 1900, for which the statistics of most exporting countries are now available, the figures for the United States were $1,453,013,659 of exports of domestic products, against $497,263,737 in 1875, an increase of nearly 200 per cent during that period, while those of Germany were in 1900 $1,050,611,000, and in 1875 $607,096,000, an increase of 73 per cent, and those of the United Kingdom, in 1900, $1,418,348,000, and in 1875 $1,087,497,000, an increase of about 40 per cent.

The very latest available data for comparing the commerce of the United States with that of other countries, however, are furnished in a statement just prepared by the Treasury Bureau of Statistics, which shows the monthly exports of domestic merchandise from each of the principal countries of the world during that period of its fiscal year for which statistics are available. This shows that the monthly average for the United States is greater than that of any other country, and that the figures of 1901 show in the case of the United States a material increase over those of 1900, while those of the United Kingdom and Germany show a decrease. The average monthly exportation of domestic merchandise from the United States in the nine months ending with September, 1901, was $113,935,020, against $112,529,440 in the corresponding months of last year, an increase of about $1,500,000 per month. while those of the United Kingdom were in the same months of 1901, $113,205,085, against $118,132,533 in the same months of 1900, showing a decrease of about $5,000,000 per month, and those of Germany were $87,831,833 per month for the six months ending with June, 1901, against $88,520,833 for the corresponding months of the preceding year, showing a decrease of a little less than $1,000,000 per month.

Average monthly export from.	1900.	1901.
United States	$112,529,440	$113,935,020
United Kingdom	118,132,533	113,205,085
Germany	88,520,833	87,831,833
France	64,299,143	66,447,000
Netherlands	53,018,558	56,790,923
India	26,382,142	31,233,845
Austria-Hungary	31,573,017	30,290,724
Belgium	28,710,857	27,994,285
Russia, European	22,608,600	26,036,200
Italy	21,124,529	21,943,518

The above table shows the average monthly exportation of domestic merchandise from the 10 principal exporting countries of the world for such portions of the fiscal year as the statistics are available, and compares the monthly figures of 1901 with those of 1900.

Transandine Railway Projects.

Receipt of inquiries from subscribers as to the Transandine Railway offering an opportunity for the securing of various mechanical and electrical contracts, has led ELECTRICAL WORLD AND ENGINEER to make a somewhat exhaustive effort to locate parties who are primarily interested in the enterprise. A representative of this journal has seen several prominent people, including bankers, railroad officials and exporters, who are in close touch with Chili, and the sum and substance of the information that could be gathered is that the railway will not be built. Some 15 years ago Clark Brothers, a large contracting firm, obtained a concession from the Chilian and Argentine governments for the purpose of constructing a road between Los Andes, a Chilian town at the foot of the Andes range, near Valparaiso, and Menoza, on the Argentine side of the mountains. The road as surveyed would be about 70 miles in length. It was proposed to construct a spiral railway up the Andes to an altitude of some 4000 ft., then pierce an 8-mile tunnel—4 per cent grade—through the mountain, and then build a spiral road down to Menoza on the Argentine side, at which point the road would connect with the Argentine railways. Up to 1896 little or nothing was done, except build the road from Los Andes about 15 miles in length in the direction of the mountains. This road, owing to the floods which occur frequently in that region, is now practically entirely destroyed. In 1896 the firm of Clark Brothers was declared bankrupt, the principal creditors being the Bank of Chili and the Bank of Tarapaca. From the date of the Clark failure up to three months ago nothing more has been heard here of the Transandine scheme. Last July a press dispatch dated London stated that J. Pierpont Morgan and others were interested in the concession for which £90,000 had been paid (presumably to the Clark creditors). Mr. Morgan, however, denies any knowledge of such transaction, while W. R. Grace & Co., who were reported to be interested in the deal, have nothing to say, except that such a matter would have been handled by their London interests, Grace Brothers & Co., Limited, of Ladenhall Street, London, E. C.

Burlington Suburban Service at Chicago.

Quite a stir was created last week by the publication in a Chicago newspaper and also in an electrical journal of the intention of the Chicago, Burlington & Quincy Railroad to operate electrically its suburban service out of Chicago, using the third-rail system, which has been patented by E. W. Farnham, superintendent of car service of the Burlington road. Mr. Farnham emphatically denied the story to a representative of ELECTRICAL WORLD AND ENGINEER, and says that his company has never even considered the electrical operation of its suburban service. A number of engineers and others interested, have been invited to witness a demonstration of Mr. Farnham's third-rail system, which is termed "The Electric Traction Power Feeder," at the Burlington freight yards at Clyde, west of Chicago, on Saturday, Nov. 2.

CURRENT NEWS AND NOTES.

WIRELESS TELEGRAPHY IN ITALY.—A Paris dispatch states that a private wireless telegraph system has been established between Spezzia and Sardinia, a distance of 122¼ miles.

STUDYING RAPID TRANSIT.—A special cable dispatch from London, Oct. 29, says: Messrs. August Belmont, John B. McDonald, Bryan, Deyo, Van Vleck and Stillwell, having completed their survey of the underground railroads of Europe, start on their return to New York to-morrow on the White Star liner "Oceanic." They have obtained much useful information for the benefit of New York City's underground road. Mr. Belmont said to-day: "We met with the greatest courtesy everywhere, and all possible opportunities of seeing what we wanted to see were granted to us. We secured much valuable data, especially regarding stations and power houses. It would not be courteous if I made comparisons of the various roads we went over. You cannot compare London's 'tube' with the New York road, for our line is being constructed on a different principle."

CZOLGOSZ EXECUTED.—On Oct. 29, at Auburn, N. Y., the assassin Czolgosz, who shot President McKinley, was "gerrycided," or subjected to the process of execution by electricity at Auburn, N. Y., State Prison. Electrician Davis administered an alternating current at 1700 volts for seven seconds, reducing it slowly for 45 seconds, and then turning it on full again for eight seconds. At the suggestion of one of the doctors, he then switched the current on once more for a few seconds, although "the lack of resistance proved that life was extinct." One of the official witnesses summoned to serve on the jury was Mr. C. R. Huntley, the well-known manager of the Buffalo General Electric Company, formerly president of the National Electric Light Association, and a friend of the McKinley family. Another juryman was Mr. Ashley W. Cole, the State Railroad Commissioner.

WIRELESS TELEGRAPHY.—It is alleged that while the "Campania" and "Lucania" were passing on the Atlantic last week, they exchanged wireless telegrams at distances up to 170 miles. The "Campania" also signaled the Nantucket lightship when 100 miles away.

HOUSE ELECTROPHONES.—It is reported in the newspapers that the London Electrophone Company has offered a tariff of $12 per annum for electrophone house service. The company, it is stated, now transmits from the Grand Opera House and the leading amusement halls and churches in the city.

DON'T BE THANKFUL.—Lord Rosebery made a speech in Birmingham, England, on Oct. 15, in which he complained of the complacent apathy of the people of Great Britain. He said they needed to be inoculated with the nervous energy of the Americans. "Be thankful," he added, was a motto that spelled decay. A satisfied nation was a lost nation.

ELECTRIC TRACTION IN SWEDEN.—The Swedish Government has ordered the directors of the State railways to prepare plans for converting the steam railways of the kingdom to electrical traction. Power will be provided by numerous waterfalls, the Supreme Court having recently decided that most of the river waterfalls belong to the crown, and not, as commonly believed, to the riparian owners.

RENOVATING BUCKINGHAM PALACE.—In the renovation of Buckingham Palace, 500 artisans are engaged. Besides repainting and redecorating the building, important structural alterations are being made in the interior. Among many other improvements are elevators, telephones and electric lights. The elevators are elctrical of American make. King Edward, while a stickler for medieval splendor and etiquette, is in many ways a man of progressive ideas.

DEVICES FOR PARISIAN POLICE.—That their heavy tread may no longer give alarm to Parisian malefactors, M. Lepine, Prefect of Police, has decreed the abolition of the top boots of policemen in favor of light, noiseless shoes. Another startling innovation is announced in the form of a so-called "lighthouse cop," with red and white incandescent bulbs on his kepi and at the end of his baton to enable the traffic brigade to convey orders at dusk to coachmen by pressing a button.

PHILIPPINE TELEGRAPHS.—Brig.-Gen. A. W. Greely, chief of the United States Signal Office, has arrived in London after five months spent in Japan and the Philippine Islands, inspecting the army and navy telegraphs and cables. After making some official investigations in London, in connection with the cable service, he will return to Washington. General Greely is well satisfied with the efficiency of the 6000 miles of cable and telegraph lines now working in the Philippines. He considers that the country and people both offer great possibilities, and he is enthusiastic over the Japanese telegraphic systems.

SUBMARINES FOR ENGLISH CHANNEL.—The question of submarine transit of the Channel is occupying the minds of inventors. M. Goubet, inventor of an electric submarine boat, has made a perfect model of a passenger boat, 25 meters long, to run by electricity on a steel wire cable at a uniform depth of 15 meters. Passengers can be carried in salon compartments, with electric light and every convenience. The passage would be as easy as a railway, with no vibration. Perfect safety is insured by an iron weight, which in case of need can be dropped, and the boat will rise to the surface. The estimated speed is 20 knots. Capital is the only thing required, says the inventor.

THE BALLOONIST SANTOS-DUMONT, who has recently attracted so much attention with his dirigible balloon in Paris, has been an active automobilist, and is now an advocate of the electric vehicle. In an article in the November *Century Magazine* he is quoted as saying: "I was once enamored of petroleum automobiles, because of their freedom. You can buy the essence anywhere, and so, at a moment's notice, one is at liberty to start off for Rome or St. Petersburg. But when I discovered that I did not want to go to Rome or St. Petersburg, but only to take short trips about Paris, I went in for the electric buggy." He uses "a dainty light-running, American buggy," for all his traveling around Paris on solid ground.

WIRELESS, ET CETERAS.—Recently the newspapers have contained cablegrams concerning what is called the Orling-Armstrong system of wireless telegraphy and telephony, in which earth currents are said to be used, and also a system of the same inventors for the wireless control of torpedo boats. This latter system appears to be the one which was exploited in the cable columns of the newspapers about four years ago, the inventor being a Swede, and apparently the same man, Orling, whose name is mentioned in the English dispatches. The "Armorli" system—as it is called—is stated to employ merely a spike at the receiving and transmitting ends in sending telephonic and telegraphic messages. Newspaper accounts refer to experiments in which, with bases 1500 ft. distant, telephonic conversation was held.

HEAVY TRACTION TESTS.—The dynamometer car owned jointly by the Illinois Central Railroad and the University of Illinois arrived in New York this week, and will be run over different divisions of the New York Central Railway. The car is in charge of Professor Edward C. Schmidt, of the University of Illinois, who is assisted by Mr. Snodgrass, one of his students. The tests are being directed by Mr. B. J. Arnold in connection with his investigation for the New York Central on the subject of heavy railway electric traction. Considerable data was obtained on the trip of the car from Chicago to New York, and a large number of tests will be made on the New York Central lines with different weights of trains. In connection with these tests information will be obtained as far as practicable on wind resistance.

A TESLA WIRELESS TELEGRAPH PATENT.—In his investigations Marconi discovered that it was desirable to have the aerial wire used in wireless telegraph in inductive relation with the transmitter or receiver circuit instead of connecting it directly thereto. A patent granted Oct. 22 to Nikola Tesla relates to such a form of inductive arrangement, and also provides for subjecting the same to a low temperature. As illustrated, the inductive element of the aerial wire is in the form of a spiral of many turns, and is immersed in a vessel containing a refrigerant. Surrounding the vessel are a few turns of conductor, which may be connected at will either to the transmitting or receiving circuit. In the specifications and claims the above arrangement is referred to as a circuit adapted to vibrate freely, and it is stated that the inventor has discovered that when such a circuit is maintained at a low temperature, the oscillations excited in the same are magnified and prolonged to an extraordinary degree. This is attributed to the increased intensity of current in the primary circuit, as well as to the greater number of oscillations obtained in the secondary circuit.

WATERWHEEL GOVERNING MECHANISM.—A patent issued Oct. 22 to Paul M. Lincoln and Lewis B. Stillwell relates to a type of hydraulic governing mechanism based to some extent upon the principle employed in the mechanism of steam steering gear, but with an important addition to provide for the case of alternators running in parallel. As illustrated, the core of a solenoid is connected to one end of a lever, the other end of which, in its normal position, is midway between two contact disks. When through a change of speed this end of the lever makes contact with one or the other of the disks, the circuit of a magnetic clutch is closed, and one of two gear wheels thereby thrown into mesh, the result being that the waterwheel gate is either raised or lowered. The solenoidal coil is mounted on a vertical shaft geared to the shaft actuating the waterwheel governing gates, so that as soon as motion is given to the latter shaft, the solenoid core is raised or lowered until it reaches such a position with respect to its core as to cause the lever to change its position and disengage the contact from the disk. When this occurs equilibrium is restored. To provide for the necessary conditions incident to parallel operation, the two contact disks are also subject to change of position with respect to the fulcrum of the contact lever. The disks are mounted in connection with governor balls on a vertical shaft receiving motion from the organization, whose speed is to be regulated. By this latter means any necessary relation between speed and load may be obtained.

LETTERS TO THE EDITORS.

The Josse Waste Heat Engine.

To the Editors of Electrical World and Engineer:

Sirs.—The article on the Josse binary vapor engine in your valuable paper of Aug. 10, I perused with great interest. The closing remarks, wherein you cite an instance of a refrigerating engine being destroyed by the action of sulphurous acid, may give rise to the belief that such destruction is unavoidable. Regarding this, I beg to remark that sulphurous acid ice machines have been built and operated for decades, especially in France, and for many years in Germany, without causing any trouble, nor has any destructive action been apparent.

When employing a machine of proper and suitable design, using pure sulphurous acid, a difficulty of the kind referred to is entirely out of the question, for SO_2 attacks metals only when water or air is present. As all pressures in the binary vapor engine are above the atmospheric, the entrance of water or air into the engine, as may be the case with refrigerating machines, is entirely exluded. In point of fact, binary vapor engines have been running the past year and a half without any difficulty of the kind arising.

EMIL JOSSE.

TECHNICAL HIGH SCHOOL, BERLIN, GERMANY.

Theory of the Edison Nickel-Iron Cell.

To the Editors of Electrical World and Engineer:

Sirs.—I have read with interest the letter of Dr. Roeber in your issue of Oct. 12 in regard to concentration changes in the pores of the plates of the Edison accumulator, and also your suggestive editorial comment on the letter.

Undoubtedly such changes take place. Whenever a current passes through an "electro-chemical field" from anode to cathode, as is well known, there is a concentration of the kations at the cathode and anions at the anode. This can be explained by the ionic theory on the ground that the ions bear electric charges and the electrostatic attraction due to the potential drop causes them to move slowly through the electrolyte. This electro-chemical movement is comparable to the falling of fine particles through a retarding medium under the influence of gravity. For example, there is a complete analogy between the mechanical falling of precipitated chalk through water and the electro-chemical transport of copper from anode to cathode in electro-plating. The friction of the particles is so great that they move not with accelerated motion, but at a constant velocity.

Granted, however, that there are such concentration changes and that the caustic potash solution becomes more concentrated at the nickel superoxide plate and more dilute at the iron plate, such changes would have small effect on the voltages of the cell.

The e. m. f. of the nickel superoxide plate against hydrogen would be at different concentrations,

$$e_1 - e_2 = \frac{0.058}{2} \log \frac{p_1}{p_2}$$

where p_1 and p_2 are the aqueous tensions of the two caustic solutions. A similar formula comes in for the positive plate. This would show that the change from a 20 per cent solution to a 1 per cent solution would make very slight difference in the voltage of the cell (not much over 0.03 volt), and not at all sufficient to account for the steady drop of voltage of the new accumulator. In the lead cell we have, however, for acid of density 1.496 a voltage of 2.29, and for acid of density 1.028 a voltage of 1.83—a difference of 0.46 volt.

So this drop in voltage due to concentration changes in the Edison cell is not at all comparable to the change of voltage due to concentration of acid in the lead accumulator, where a more complicated formula, due to the fact that both the dissolved substance and the solvent take part in the electro-chemical reaction,

$$(Pb O_2 + Pb + 2 H_2 - SO_4 = 2 Pb SO_4 + 2 H_2 O)$$

must be deduced. We also see from the above equation that the changes in concentration in the pores of the plates are much more important with the lead cell than with the new Edison accumulator, as well as producing more effect on the voltage.

The change in the resistance of the Edison electrolyte in the pores of the plate is negative; that is, the resistance of the positive increases more than the negative decreases. This will account for some of the fall in the discharge, but not for all.

The drop is probably due in great part to the fact that at first the current acts electro-chemically on the particles of oxide in the best electrical contact with the plate, and at the end of discharge must find as its depolarizer, oxide electrically remote from the plate. A corresponding drop will be found also at the iron plate. The most important consideration is the resistance of the briquettes as affected by changes of the discharge and charge as well as by changes of the resistance of the electrolyte. Certain compounds as NiS, FeS, PbS, Fe_3O_4, PbO_2, and CuO act as fairly good conductors of the first class. In the Edison cell, the oxides must be conductors to some extent.

The probable reason for the so-called electro-chemical "passivity" is the fact that the products of the electrolysis are insulators, and so protect inside layers. The strength of the lead cells is in the Pb and PbO_2 as metallic conductors, while conversely its weakness lies in the lead sulphate. The strength of the new Edison accumulator partly lies, no doubt, in the fact that the products of the electro-chemical action conduct, but largely also in the skillful combination of mechanical and electro-chemical treatment in the manufacture of the plates by the inventor.

WOOLSEY MCA. JOHNSON.

TRINITY COLLEGE, HARTFORD, CONN.

Some Elementary Requirements in Export Trade.

To the Editors of Electrical World and Engineer:

Sirs.—We are readers of your valuable "Export Issue," and have acquired some first-class sole selling agencies for this country through it. We are go-ahead people, but we cannot run our heads through a wall; that is to say, the people and business usages of different countries must be taken into consideration, which very few manufacturers do.

America is no doubt ahead of any country as far as inventions and manufacture go, also as to prices and time of delivery, and this country is about the slowest, but pays best prices for electrical appliances and novelties, of which we make distribution. Everything new is looked upon with suspicion here, even if testimonials from another company's experts are produced.

We do not exactly know the commercial way of working in the United States of America, but must infer that there are different methods from those here. The experience we have in dealing with American manufacturers has been the following, which are no doubt drawbacks that could be done away with if manufacturers on your side would know and notice them:

It generally takes three weeks before we can get an answer to our letters, but if the mail steamer's name is put on outside of the envelope on each side of the pond and it is posted on mail days, at least four to five days' time can be saved. Most manufacturers do not answer letters on day of receipt, and we have had instances where we have had to correspond and wait for replies, etc., so that it has taken us three and four months to fix up an agency, and we believe outside the loss of time many firms here would have given it up. The correspondence has also mostly been to point out how business could and ought to be done here, while United States of America manufacturers only seem to judge by their country's methods.

An agency for the sole sale of a manufacturer's specialties is the best here, and to the manufacturer's interest, because if he allows several jobbers to export, price-cutting will soon spoil the sale of the article and nobody can make any profit. We find that American manufacturers are very slow to understand this, and that they ought to protect their sole agent or contractor, and at least tell all buyers on your side that goods cannot be shipped to Great Britain, as the sole-selling right has been granted to a London firm, and also all inquiries and orders from this country ought to be sent back to the agent.

Hardly any firm here will buy merely from illustrations and samples, but if orders are given they want goods at once delivered and will either pay cash with order or against documents, but only after they have seen the goods. The manufacturers do not want to sell except on one of the above terms, and therefore no business can result unless the agent or contractor does it. For this and the expenses to introduce and promote the manufacturer's goods, the strict enforcement of the sole selling rights, we think, ought to be granted. Of course, the agency is only given for a certain time to give the manufacturer as well as the agent chances both ought to have.

Further, the United States of America manufacturer expects orders at once, and in many instances imposes certain conditions, but he will not protect his agent as mentioned above, and tries to make

his only object to force orders, and often in unfair ways. If orders are not forthcoming at once, answers to letters may not be expected any more.

Another point, nearly half of the United States of America firms do not frank their letters sufficiently. This is a common complaint here. We have paid from 10 to 50 cents a letter, simply because we expected some important news, and if we were to let the letter go back three weeks' time would be gone. The contents were often circulars, which could have been sent for 2 cents "per bookpost" up to 2 ounces. Letters ought to be weighed, the postage being 5 cents *for every half* ounce weight. Post cards 2 cents.

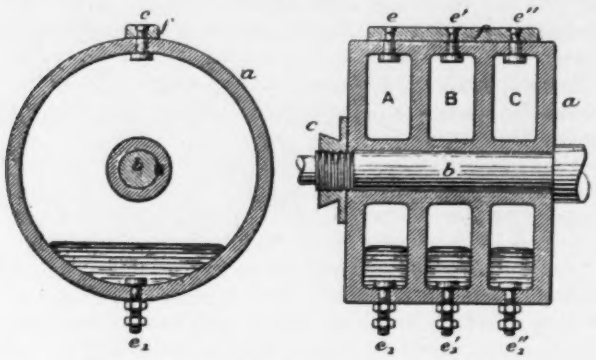
We must say that we are surprised that most of your manufacturers lack such commercial smartness as against their other cleverness and superiority. But they ought to remember other countries' usages and have more patience, else they will "kill the goose that is expected to lay the golden eggs" and do no business.

THE EXCELSIOR ELECTRIC COMPANY,
LONDON, ENGLAND. J. ALEXANDER, *Manager*.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS

Starting Three-Phase Induction Motors.—An illustrated description of a device of a French company for starting three-phase induction motors, a resistance being in the secondary circuit when the motor is started, and being automatically cut out when the motor has run up to a certain speed. The device can be seen from the adjoining figures. A cylinder *a* of insulating material is mounted on the axle *b*



STARTING THREE-PHASE INDUCTION MOTORS.

of the secondary of the induction motor and revolves with it. This cylinder is divided into three parts *A, B, C,* insulated from one another. In the walls of each of these three parts, there are two metallic screws at two diametrically opposite points, *e* and e_1, *e'* and e_1'', *e''* and e_1''. The three screws *e, e'* and *e''* are connected together by the metallic rod *f;* on the other hand, the other three screws e_1, e_1', e_1'', are insulated from one another and are connected to the three points in which the star connected armature windings of the motor are connected with starting resistances, placed in the armature. It is evident that as long as the three screws e_1, e_1', e_1'' are insulated from another, the starting resistance is inserted in the armature, but when these three screws are connected together by a conductor, it has the same effect as if the starting resistances were cut out. For this purpose a certain amount of mercury is placed in the drum. When the motor starts and runs up to full speed, the mercury is revolved, and, on account of the centrifugal force, finally forms itself into a ring, so that it covers the whole of the walls of the three compartments. The screws *e', e₁₁, e₁''*, are thus connected through the mercury to the three screws *e, e', e''*, and as the latter are connected together by the conducting rod *f*, the former three screws are short circuited. By adjusting the amount of the mercury, the moment at which the starting resistances become inactive may be varied.—*L'Ind. Elec.*, Oct. 10.

Operation of Alternators in Parallel.—A report on the discussions of a section of the Int. Soc. of Elec. in Paris on this subject. The coefficient of irregularity of a steam engine is defined as the difference between maximum and minimum speed, divided by double the average speed during one revolution. It has also been proposed not to give the coefficient of irregularity, but the maximum angular deviation of the crank from an ideal crank which revolves with uniform speed, the latter value is more important than the coefficient of irregularity. Electrical engineers are asked to give their opinion on the greatest value which should be allowed for the angle, representing the maximum angular deviation, or rather for the product of this angle with half the number of poles of the alternator. Labour allows an upper limit for this product of 45 degs. Under these conditions he was able to operate in parallel alternators driven by steam engines with others driven by turbines which were at a distance of 48 miles from the former. When an alternator with a frequency of 50 is in service alone, the above mentioned product may be 60 degs., without affecting the apparent constancy of the voltage. He also suggests a method for determining the mass of the flywheel which limits the above angle to 45 degs., for alternators of a frequency of 50. Some data are given by Chevrier, Loppe, and David on the behavior of steam engines.—*L'Eclairage Elec.*, Sept. 21.

Synchronous Converters.—THORNTON.—The conclusion of his paper on synchronous converters and phase-swinging. He gives the mathematical theory of the energy dissipated in the core and then discusses the effect on the generator. The immediate effect of phase-swinging on a generator is to vary periodically the retarding torque. If the disturbances are synchronous with the fluctuations of crank effort, there is a cumulative oscillation imparted to the magnet wheel which aggravates the current fluctuations in the circuit and may in time lead to one or all of the converters breaking step. A somewhat sluggish governor is thus an advantage, for the electric disturbances are rapid impulses rather than sustained loads. Flywheel design for synchronous motor driving is really a question, in the first place, of motor design, so that the moving parts may not be subjected to synchronous oscillations of load between governor and motor. There will, however, be a minimum weight of wheel for each motor or converter on the circuit. This will depend on the variations of the engine power, and on the mechanical disturbances experienced during the phase-swinging of the rotaries, though these may not be synchronous. He discusses this question mathematically.—Lond. *Elec.*, Oct. 4.

REFERENCES.

Induction Motors.—TRYLSKI.—An illustrated description of large three-phase induction motors, built by Alioth Co. for driving air compressors. Each has a capacity of 500 horse-power, the speed being 100 r. p. m., the voltage 5000, the frequency 25.—*L'Eclairage Elec.*, Aug. 31.

Graphical Theory of Synchronous Motors.—VERHOEKX and BLONDEL.—A communication by Verhoekx referring to a special point of Blondel's paper on the graphical theory of synchronous motors (Digest, Aug. 10). He gives a graphical method for determining the wattless current as a function of the excitation at constant power. Blondel replies that Verhoekx's method, although interesting, does not accomplish more than his own method.—*L'Eclairage Elec.*, Sept. 14, 28.

POWER

Large Transmission Plant.—A note on the projected large power transmission plant at the Urft, for supplying electricity to Enskirchen, Dueren and Aachen in Germany. There will be eight 1280-hp turbines, direct coupled with dynamos, and they are expected to yield 8000 horse-power in the winter, and in the summer at most 6000 horse-power. The cost of 1 horse-power-hour has been calculated at 0.125 cent at the turbine, but by transmission the cost will increase to 0.25 to 0.38 cent. The cost of the dam is calculated at $920,000, and the cost of the whole installation at about $1,250,000.—Lond. *Eng'ing*, Sept. 27.

REFERENCES.

British Three-Phase Colliery Installation.—An illustrated description of the system of power transmission at the Denaby and Cadeby

collieries which have recently installed a very satisfactory three-phase power station and haulage plant. The haulage plant is driven by two 110-hp induction motors, while other induction motors are used for driving pumps, a pug-mill and a stone breaker.—Lond. *Elec. Rev.*, Sept. 27.

Wind Turbines for Generating Electrical Energy.—CORZ.—An account of a test made during a whole year. The trial station consisted of a wind turbine of a maximum capacity of 50 horse-power, a 30-hp dynamo, a large battery, a switchboard, a power transmission for supplying 7 horse-power daily for 10 hours, and a lighting installation of 20 incandescent lamps of 16 cp. The trial station was in a windy country, and the 7 horse-power for power and 3 horse-power for light were obtained every day without exception.—*Elek. Anz.*, Sept. 29.

Electric Pumps.—HICKS.—A paper read before the Pac. Coast Elec. Transm. Ass'n on possibilities and limitations of electric pumping. He deals with feed and circulating pumps, the use of Stork pumps, deep well pumps, pumps for irrigation, the operating of mining pumps and centrifugals for water works. He gives brief descriptions of several pumping installations. He is somewhat in favor of a rotary or centrifugal type, because of the advantages and possibilities offered by reason of the single revolving element in direct connection with electric motors. An account of the discussion which followed is also given.—*Jour. of Elec.*, Sept.

Electric Equipment of Cranes.—RUNG.—A continuation of his illustrated article. In this part he deals with controllers for both direct and alternating-current motors for cranes.—Lond. *Elec. Rev.*, Sept. 27.

Climate and Power Transmission.—MCADIE.—A long and well illustrated paper, read before the Pac. Coast Elec. Transm. Ass'n, on "Climatological influences and electric transmission." He deals especially with the influence of fog and with the climatological conditions at the Pacific Coast.—*Jour. of Elec.*, Sept.

California Power Transmission.—GALLOWAY.—A well illustrated article on the 142-mile electric power transmission plant of the Bay Counties Power Co., Calif.—*Eng. News*, Oct. 3.

DUTCHER.—A long abstract of his Pac. Coast El. Transmiss. Ass'n paper on the transmission line construction of the Bay Counties Power Co.—*Eng. News*, Oct. 3.

TRACTION.

Conduit Railways.—Three profusely illustrated articles, one anonymous, the second by Connett, the third by Philipps. There are three different systems of conduits, the side slot throughout, as in Brussels; or the side slot deflected to the center at track points, as in Paris; or the center slot, favored mostly in the United States. Of these three the deflected side slot is thought to be the best, as there is not such a heavily iron-clad road surface as with the center slot, and the interconnected track and plough points, unavoidable with the undeflected side slot, are obviated. There are now 270 miles of conduit tramways in the world. A few details of construction on the most important lines in different cities are given. Connett's objections to the conduit are: The cost of installation; dependence upon the municipality for a fairly effective system of sewers; the change from trolley to plough or vice versa to allow through cars to run over both; increased cost of maintenance and renewals of special track work due to the slot frogs and switches; greater care and attention necessary in the maintenance of the plough than of the trolley. But he adds that "despite these objections, the open slot conduit is in his judgment by far the best and most economical method of operating a metropolitan street railway in the present stage of electrical development, when overhead rights cannot be secured. From estimates of the cost it appears to be possible to construct rather more than twice the mileage of overhead trolley for the money required by the conduit."—*Traction and Transm.*, June; abstracted in Lond. *Elec. Rev.*, Oct. 4.

Electric Railway Matters.—An editorial summary of several new schemes and developments. In Great Britain the contract for the electrical conversion of the Mersey railways has gone to the Westinghouse Co. The cost of operation, which is now 31 cents per train-mile for steam traction, is expected to be reduced to 13.5 cents with electric working. One section of the Behr monorail system is expected to be completed in the spring of 1903; but the entire road between Manchester and Liverpool may not be ready before 1905. The Prussian R'y Administration has reported on the electric railway equipments on the Wannsee line (third-rail suburban line), and elsewhere. While electricity is considered to have many advantages, it is said to compare very unfavorably with steam in regard to cost. Quite a number of electric railway schemes which are so far only propositions, are also mentioned.—Lond. *Elec. Rev.*, Oct. 4.

Electricity on the Belgian Light Railways.—A note on the introduction of electric traction on the Belgian light railways. The rolling stock consists of 22 motor cars and 22 trailers, the former carrying 35 and the latter 40 passengers. The current is supplied to the cars by overhead trolley wires supported on side poles. To reduce risk of electrolysis, there is a return conductor consisting of old rails laid in concrete, which is connected up to the main rails at every 85 meters. The motor cars each have two 30-hp motors. Since the change was made the patronage of the lines has increased 40 per cent. —Lond. *Eng'ing*, Oct. 4.

New York Rapid Transit Subway.—A description of the work now being carried on in New York City for the construction of the new Rapid Transit Subway. Drawings are shown of the type of construction used. For the greater part of the distance the Subway is but a short distance under the streets, and the work proceeds by excavation, although in a few places deep tunnels are being run where the distance below the surface is too great to use the usual method. At one place a depth of over 100 ft. is reached. Compressed air is used extensively in operating hoists and rock drills. In numerous places the excavation is in solid rock. Electric cranes are used in some places instead of compressed air. The fixed charges in this Subway will probably be approximately the same per mile of track as on the Manhattan Elevated Railway in the same city, although as yet there is no means of determining this definitely.—*St. R'y Jour.*, Oct. 5, and Int. Ed., Oct.

Some Railway Problems of Brooklyn.—GREATSINGER.—A discussion of the various local conditions adverse to the proper supplying of transportation facilities in the Borough of Brooklyn. By far most passengers use the lines for transportation to Manhattan. One of the greatest obstacles to good service on the through trains is the limited capacity of the bridge across the East River. This bridge is now loaded to its utmost capacity, but two other bridges are in prospect and a tunnel will soon be commenced. Plans were made some time ago for the enlargement of the generating capacity and work has been commenced upon a large new power station. The supply has been so small, however, that the electrical operation of trains on the elevated railroad has been suspended, and the company has bought high-tension current from the lighting company, a separate concern, which it has transformed into its ordinary railway direct current. It is expected that when the power development contemplated has been completed, a sufficient supply will be obtained to last until 1906, the power being doubled from what it is at present by the addition.—*St. R'y Jour.*, Oct. 5, and Int. Ed., Oct.

Barbillion and Griffisch Traction System.—REYVAL.—An illustrated description of this system which is intended to combine the advantages of the conduit system with those of the surface control system, to be less expensive than the conduit system and safer than the surface contact system. There is an entirely closed conduit below the track. A small motor carriage runs in this conduit with a speed which is always above that of the motor car on the track. The small carriage in the conduit makes contact between the contact blocks and the main, and is arrested on its way by a series of catching devices, each corresponding to a surface contact plug. When the motor car on the track reaches such a point, it releases the small carriage in the conduit so that the latter then continues its run and goes ahead to the next surface contact plug, and so on. The arrangement of the system is described in detail and illustrated.—*L'Eclairage Elec.*, July 20.

REFERENCES.

Tram Car Motors.—COLLISCHONN.—A description of motors of Lahmeyer & Co. The air-gap between the pole pieces and the armature is 4 mm. The engravings show that all parts are easily accessible. The number of armature coils is between 33 and 37. The motors are rated on the basis of continuous run under full load for one hour, with a rise in temperature not over 70 degs. C. above the surrounding temperature. Particulars are given of three of the types of the motors made by the company.—*St. R'y Jour.*, Int. Ed., Oct.

Surface Contact System.—REYVAL.—An illustrated description in detail of the surface contact system of Felice, Tosi and Parboni. The feature of the system is a special commutator or contact box claimed

to be of solid and simple construction, so that the system is said to be less expensive than other surface contact systems. The system has been experimented with for six months in Rome on a trial line with good results.—*L'Eclairage Elec.*, Aug. 10.

Rolling Stock.—Chamberlin.—An illustrated article on the rolling stock of Greater New York.—*St. R'y Jour.*, Oct. 5, and Int. Ed., Oct.

Car Maintenance.—Millen.—An illustrated article on car maintenance on the Metropolitan Street Railway in New York.—*St. R'y Jour.*, Oct. 5, and Int. Ed., Oct.

Tramway Transfers.—Root.—An article on transfers and transfer problems with special relation to New York.—*St. R'y Jour.*, Oct. 5, and Int. Ed., Oct.

Street Railway Convention.—A full account of the proceedings at the recent convention in New York is given in the daily editions of the *St. R'y Rev.*, Oct. 9 to 12.

Installations. Systems and Appliances.

Gas and Electricity.—Martin.—A paper read before the Pac. Coast Gas Ass'n on "Practical power transmission." He first speaks of the limitations of water power transmission, due to the lack of uniform flow of water in the streams during the different seasons of the year. He then speaks of combined gas and electric plants. He recommends that managers of gas plants also to take up electric distribution. Whenever current can be had from an electric power transmission company he recommends buying it instead of generating it in a local station, even though the cost may be 15 or 20 per cent greater. His argument is that the capital which would be spent for building a generating station can better be expended in developing an electric distribution system. He has followed this course in the plants which he manages, with good success. In his plant in Marysville the electric department is the more profitable for two reasons: Because he does not have to carry the cost of a generating plant, and because he recommends gas only for fuel purposes, but he "pushes it hard" for that. He is in favor of flat rates for electricity, to educate the people. He lights a three or four-room house for one dollar a month. With this class of small consumers he gets more money from a block of ground than he does in the better residence districts.—*Jour. of Elec.*, Sept.

Wires, Wiring and Conduits.

REFERENCE.

Potential of Insulated Cable Networks.—Guyer.—A French Society note on "The absolute value of the potential in insulated networks representing capacity." This absolute value of the potential is of importance for determining the insulation required for the different parts of the network against earth. He gives the general mathematical solution of the problem and applies it to special cases.—*Comptes Rendus*, v. 133, p. 388; abstracted in *L'Eclairage Elec.*, Sept. 21.

Electro-Physics and Magnetism.

Reality of Atoms.—Ruecker.—The conclusion of his presidential address to the Brit. Ass'n, the first part of which was abstracted in the Digest, Oct. 12. He explains why it is necessary from the outset to assume that atoms have properties different from those of matter in bulk. He says that though the fundamental assumptions of the atomic theory receive overwhelming support from a number of more detailed arguments, they are themselves almost of the nature of axioms, so that the simplest phenomena are unintelligible if they are abandoned. He then speaks of the atomic theory of magnetism, and of the theory of ions in gases. It is "from the theory of ions that the most far-reaching speculations of science have recently received unexpected support." He then speaks of the magnitudes and mean free paths of atoms. The question whether the model of the atomic theory is unique, is answered by the statement that the atomic theory must hold the field until another can be found which is not inferior as an explanation of the fundamental difficulties as to the constitution of matter, and is, at the same time, not less comprehensive. He then speaks of the phenomena of life and of the limits of physical theories. He concludes that "in spite of the tentative nature of some of our theories, in spite of many outstanding difficulties, the atomic theory unifies so many facts, simplifies so much that is complicated, that we have a right to insist—at all events, until an equally intelligible rival hypothesis is produced—that the main structure of our theory is true; that atoms are not merely helps to puzzled mathematicians, but physical realities."—Lond. *Elec., Elec. Eng.*, Sept. 20.

Change of Conductivity of Metallic Particles Under Cyclic Electromotive Variation.—Bose.—A long Brit. Ass'n paper, illustrated by diagrams. Under the action of electric radiation the conductivity of metallic particles exhibits variation. In the positive class like iron, there is an increase, and in the negative, like potassium, a diminution of conductivity. Each class again falls into two sub-classes: Sensitive substances which undergo self-recovery, and such which do not. In the case of self-recovery substances the conductivity distortion varies with the intensity of radiation. Under the continued action of radiation, the distortion attains a maximum, balanced by force of restitution, and on the cessation of radiation there is an elastic self-recovery. The three classes of substances, positive, negative and neutral, may be distinguished by their peculiar characteristic curves. The change produced in the sensitive substance by the action of radiation is not, normally speaking, chemical. The conductivity change is produced not only by very rapid, but also by comparatively slow electric variation. Generally speaking, all the conductivity variation effects, produced by electric radiation, can be reproduced by comparatively slow cyclic electromotive variation. These conductivity changes under cyclic e. m. f. variation may be continuously recorded by means of the conductivity curvograph. Electric conduction in metallic particles sensitive to electric radiation does not obey Ohm's law. The conductivity is not constant and independent of the e. m. f., but varies with it. In the positive class the characteristic curve, in which the ordinates represent the currents and the abscissæ the e. m. f., is concave to the axis of the current. The conductivity increases continuously with increasing e. m. f. The variation of conductivity in the lower portion of the curve is small, but increases with great rapidity in the upper portion. The curve obtained with a strong initial current, is steeper than with a feeble one. There is found, especially when the initial current is feeble, a critical e. m. f., at which the conductivity change becomes so rapid as to produce an almost abrupt bend in the curve. Stronger initial current appears not only to lower the critical point, but also to mitigate the abruptness of this change. The effect of e. m. f. in modifying the conductivity of the conducting layer, is well seen in self-recovering substances. There is a definite conductivity corresponding to a definite e. m. f. As the e. m. f. is increased, the sensitive molecular layer is strained, and a definite increase of conductivity produced. When the increase stress is removed, the corresponding strain also disappears, and there is an elastic recovery to its former molecular and conductive state. Hence when it is carried through a complete cycle of e. m. f. variation with moderate speed, the substance is at the end again in its original molecular condition. This is the case where there is a complete cyclic recovery on the removal of the stress. With non-recovering substances an outstanding residual effect is found, like hysteresis.—Lond. *Elec.*, Sept. 20, 27.

Vibrations of Incandescent Lamp Filaments.—Kempff-Hartmann.—The filament of an incandescent lamp is thrown into rapid vibrations in the cold state by the slightest disturbance. If it is held to the ear, a metallic note is heard, which appears to consist of several notes not harmonically related. When the lamp is burning, the oscillations die away rapidly. This is not due to a loss of elasticity, but probably to a magnetic damping effect. The incandescent filament may be kept in a state of vibration by the simple device of bringing a magnet into its neighborhood, provided that either the lamp or the magnet are fed by an alternating current.—*Phys. Zeit.*, Aug. 24.; abstracted in Lond. *Elec.*, Sept. 20.

Magnetism and Viscosity.—Gray.—An abstract of a Brit. Ass'n Adv. of Sc. paper on "The influence of a magnetic field on the viscosity of magnetizable liquids and solids." The liquids used were ferrous sulphate and ferric chloride. A diminution in the viscosity was observed when the flow of fluid was along the lines of a rather weak magnetic field. With the flow of the fluid at right angles to the magnetic lines, however, no change in the viscosity was observed. The experiments on solids were made by observing the variation in the torsional damping of a loaded vertical wire when longitudinally magnetized. Soft iron wire exhibited marked reduction in its viscosity as the magnetic induction was increased. Precisely the opposite result was obtained with nickel.—Lond. *Elec.*, Sept. 20.

REFERENCES.

Duality in Electricity.—De Vilar.—A continuation of his former researches (Digest, Aug. 3). He applies this principle of dualism to

the theory of sinusoidal alternating currents and discusses at some length the "reciprocity between generating circuits and receiving circuits" for several special cases. The results obtained by his analysis are illustrated by diagrams.—*L'Eclairage Elec.*, Aug. 17.

Electric Spark.—NECULCEA.—An illustrated article on the electric spark, on the part of the self-induction in an oscillating discharge, and on spectra produced by the electric arc.—*L'Eclairage Elec.*, Aug. 10.

Photo-Electric Cells.—MINCHIN.—A very brief note on a Brit. Ass'n Adv. Sc. paper in which he described the manner in which the selenium cells are made, and the way in which they may be used for measuring the radiant energy of the stars.—Lond. *Elec.*, Sept. 20.

ELECTRO-CHEMISTRY AND BATTERIES.

Stassano Electro-Metallurgical Process.—FUMERO.—An article on this process which aims at replacing the heat of combustion of the coal in the ordinary metallurgy of iron by the electric arc, and should be advantageous in countries where fuel is costly and water power cheap. The roasted and powdered ore is first of all passed through a magnetic separator in order to prepare a material rich in iron. This is then analyzed and the amount of carbon required for its reduction, calculated. The mineral is then mixed with the necessary amount of powdered wood charcoal and tar, whose percentage of carbon is known, and a slag-forming material, and made into briquettes. These are then introduced into the electric furnace. The chemical reaction is at first very lively, but becomes quieter after a time, and the amount of heat necessary continually decreases. A furnace of 150 horsepower yields in 1½ to 1¾ hours nearly 30 kilograms of wrought iron. By varying the amount of carbon added according to the previously made analysis, it is possible to prepare a cast iron with a certain fixed percentage of carbon. The plant at present working is at Darfo in the province Brescia in Italy, and uses a fall of 30 meters of 5 cubic meters water per second.—*L'Elettricita*, v. 20, p. 161; abstracted in *The Elec. Chem. and Met.*, Sept.

Polarization and Internal Resistance of Electrolytic Cells.—ATKINS.—The conclusion of his paper in which he reaches the following conclusions. Electrodes of copper in copper sulphate, and amalgamated zinc in zinc sulphate, when freshly placed in their respective solutions, give, with varying currents, curves completely satisfied by a formula of the Bartoli-Wiedeburg form, and its derived equations. Electrodes of silver in silver nitrate and zinc sulphate, as a rule, give curves satisfied by such a formula. Electrodes of polished platinum in sulphuric acid do not, as far as investigated, conform to the formula. The maximum value for the polarization, however, is in agreement with that found by other methods. Electrodes of all these metals in their respective solutions, show upon standing a marked increase in apparent resistance. All results obtained concur in their testimony that this is not an increase in the real resistance of the cell. While the theory of Wiedeburg is not sustained as to its constants by the results of this research, an equation of the same general form would seem to be suggested as satisfying the curves for internal resistance and polarization of electrolytic cells.—*Phys. Rev.*, Sept.

REFERENCES.

Storage Batteries.—Brief illustrated descriptions, taken from patent specifications, of the following batteries: Loppe, Morin, Martin and Griner, Luzard, Wiegand, MacRae, Bowker, Goldstein, Bary.—*L'Eclairage Elec.*, Sept. 14.

Platinum Electrode.—A description with illustration, of the Heraeus platinum electrode, recently noticed in the Digest.—Lond. *Elec.*, Oct. 4.

Training of an Electro-Chemist.—HUTTON.—A communication in which he points out that the would-be electro-chemist should, to start with, have a first-class chemical training.—*The Elec. Chem. and Met.*, Sept.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Alternating-Current Terminology.—An editorial note criticizing the use of the term "wattless," especially in the connection "wattless power" and "wattless watts." It is proposed to use instead the term "fictive power," while "real power" is the product of e. m. f., current and the cosine of the phase difference. As the cosine of the phase difference between e. m. f. and current is called the power factor, it is proposed to call the sine the powerless factor or co-power factor (*facteur d'impuissance* or *facteur de copuissance*). For the two components of the current it is proposed to use the terms: Current in phase and current in quadrature.—*L'Ind. Elec.*, Oct. 10.

Localizing Faults.—MURPHY.—An illustrated article on a modification of the Blavier test. He has worked out a method for localizing a fault with minimum assistance at the further end. This assistance at the distant end consists in depressing and raising a key every alternate minute, for about 10 minutes. By depressing the key the line is directly earthed; by raising it, it is earthed through a certain resistance. He shows that if the normal resistance of the line is subtracted from the results obtained with the key at the distant end depressed in the first place and with the key raised in the second, and the ratio of the differences ascertained, a simple formula enables the distances of the fault from the far end to be quickly and easily calculated.—Lond. *Elec.*, Oct. 11.

Disk Interrupter for Alternating Currents.—RUHMER.—A description of some improvements in the liquid interrupter with exchangeable perforated plates. The electrodes are introduced through the sides, thus obviating gliding sparks which might lead to explosions. By making one electrode of lead and the other of aluminum, he has succeeded in producing an apparatus which only interrupts the alternating current in one direction. This is of special utility in Röntgen ray work. The life of an aluminum electrode is about 500 hours.—*Phys. Zeit.*, Sept. 21; abstracted in Lond. *Elec.*, Oct. 4.

REFERENCES.

Alternating-Current Measuring Instruments.—ADDENBROOKE.—His paper in full, presented to the Internat. Elec. Congress in Paris last year, on electrostatic voltmeters, ammeters and wattmeters for alternating currents.—*L'Eclairage Elec.*, Aug. 24.

Galvanometers.—MENDELHALL and WAIDNER.—An illustrated description in detail of a new galvanometer of high sensibility, devised by them. It is of the ordinary four-coil Thomson type, the materials used being brass and glass, with insulating fiber supports for the coils.—*Am. Jour. Sc.*, Oct.

Phase Meter.—LETHEULE.—An illustrated description of the Holden phase meter for three-phase currents and for single-phase currents.—*L'Eclairage Elec.*, Aug. 3.

Maximum Demand Indicator.—ARMAGNAT.—An article giving brief illustrated descriptions taken from British patent specifications of new maximum demand indicators of Barker and Ewing, Rimington, Wright, Fish; two devices due to Cox and Dick, respectively, for using a single maximum demand indicator on a three-wire system; also a meter of Macdonald for variable tariff, the tariff varying continually according to a law taken from the average daily load curve.—*L'Eclairage Elec.*, Sept. 14.

TELEGRAPHY. TELEPHONY AND SIGNALS.

Simultaneous Multiplex and Ordinary Telegraphy.—MERCADIER.—The simultaneous transmission of telegraphic and telephonic messages over the same wire is rendered possible by the difference in the effects produced by continuous and oscillating currents, respectively. It follows that any system of telegraphy in which oscillating currents are used, offers the possibility of a simultaneous transmission of continuous and oscillatory messages. Such a system is that of Mercadier who operates with electric tuning forks. He has tested the possibility above indicated in a practical way and on a large scale, and has succeeded in completely establishing it. The line worked with was that between Paris and Bordeaux. Among the various forms of auxiliary apparatus devised by Van Rysselberghe, Maiche, Cailho, Picard, etc., that of Cailho was chosen and 12 simultaneous messages were transmitted by Mercadier's system, together with signals, with the House, Hughes or Baudot transmitter. Since messages can be sent in both directions, this means that one wire can carry 25 messages at a time, together with extra messages between intermediate stations.—*Comptes Rendus*, Sept. 16; abstracted in Lond. *Elec.*, Oct. 4.

REFERENCES.

Submarine Cables.—LAROSE.—A long article on the dragging for submarine cables in great depths. He discusses the difficulties and gives practical rules for the best methods of dragging.—*L'Eclairage Elec.*, Aug. 10.

Telephone and Telegraph Wires.—LAWRENCE.—A mathematical article, with diagrams, on tension and sag in telephone and telegraph wires.—*Tele. Mag.*, Sept.

Wireless Telegraphy.—Johnson.—A purely mathematical article on the Hertz exciter and its application in wireless telegraphy.—*L'Eclairage Elec.*, Aug. 3.

Wireless Telegraphy.—Turpain.—An article giving illustrated descriptions, taken from United States patent specifications, of several new inventions and improvements in wireless telegraphy. Quite a number relate to Kitsee, Collins' coherer and oscillator; Walter's transmitter and receiver for assuring the secrecy of message.—*L'Eclairage Elec.*, Sept. 21.

Telephone System for Railways.—Barbillion.—Several diagrams showing a modification of a system of telephonic connection between several stations along a railway, for the special purpose of facilitating the direct intercourse between two important stations, like those at the two terminals of the line.—*L'Eclairage Elec.*, Aug. 24.

Railway Signals.—Pigg.—The first part of an illustrated article on English and American railway signaling.—Lond. *Elec. Rev.*, Sept. 27.

MISCELLANEOUS.

REFERENCES.

Manufacturing Plant.—A continuation of the well illustrated serial on the recent visit of the Brit. Inst. Elec. Eng. to Germany. This part deals with Schuckert's works, and especially a revolving light synchronizer and a transformer switch for switching out the primary circuits of transformers as soon as the secondary circuit is open, and switching in again as soon as it is closed.—Lond. *Elec.*, Sept. 27.

Glasgow Exhibition.—An illustrated description of exhibits of Mather and Platt. Direct-current dynamos and motors, motor-driven pumps, an electric drill and an electric conveyor.—Lond. *Elec. Rev.*, Sept. 27.

A brief illustrated review of a few electro-metallurgical exhibits at this exposition, the only metals concerned being nickel, copper and zinc.—*The Elec. Chem. and Met.*, Sept.

Paris Exposition.—Reyval.—An illustrated description of a 132-kw, 120-volt direct-current generating set for ship lighting exhibited by Sautter and Harle.—*L'Eclairage Elec.*, Sept. 7. An illustrated description of a 122-kilovolt-ampere, three-phase alternator of the induction type of Siemens & Halske, of Vienna, the voltage being 2100, the frequency 50, the speed 759 r. p. m.—*L'Eclairage Elec.*, Sept. 14. Illustrated description of a 350-kw, 250-volt direct-current dynamo, exhibited by a French metallurgical company; of a 260 kilovolt-ampere, 200-volt Kolben three-phase alternators, exhibited by the Decauville Co., and of a 175 kilovolt-ampere, three-phase alternator and a 60-hp, three-phase induction motor of the Cie. de Fives-Lille.—*L'Eclairage Elec.*, Sept. 21. Illustrated descriptions of a 375-kw and a 75-kw, 550-volt, direct-current dynamo, exhibited by the Postel-Vinay Co.; also of direct-current machines of the Cie. de Fives-Lille; a 220-kw, 550-volt and a 100-kw, 500-volt traction generator, and a 36-kw, 120-volt dynamo; also of a 400 kilovolt-ampere, three-phase alternator of Rieter & Co., the voltage being 220, the frequency 45.—*L'Eclairage Elec.*, Sept. 28.

Tripier.—The first part of a very long and detailed description of the electric railway used at the Exposition. The track construction and the signal system are described in the present part.—*L'Eclairage Elec.*, Sept. 7.

New Books.

Recording and Integrating Electric Meters. How to Inspect, Repair, Test, Calibrate, Read and Compute Meters. By Robert Ferris. Monmouth, Ill.: Robert Ferris. 47 pages, illustrated. Price, $1.

This treatise is a gem. Not for an instant could the reviewer hesitate to heartily recommend the purchase of a copy to every one who even imagines that possibly some day they will be interested in electricity. Those who have as yet foregone a technical education will find the statements in the book so curiously and wonderfully involved that they cannot possibly learn anything from it that would hurt their minds (we say nothing about helping them), while those who are a little further along can get a fair average of two laughs per page out of it, not to mention the aggressively apparent moral of the whole: Refrain from attempting to say what you cannot express, and don't imagine that a smattering of knowledge means mastery of a subject.

Like Gaul, the volume is divided into three parts. Unlike it, the parts are not named, but start in with numbered paragraphs reading as follows:

"Any man of the average intelligence can become an expert meterman." "A short run through the primary of electricity will now be in order," and "The points to consider in selecting a meter are the particular points we want to be able to test. They are as follows: Accuracy on non-induction load, accuracy on induction load, ordinary volt-ampere accuracy, etc., respectively."

We might suggest that the parts be given the titles "Hickory," "Dickory" and "Dock," which would describe the contents as well as anything else and have the advantage that their familiar sound would make the readers feel at home at once. Part I. is explained in paragraph 6 as being "a little run through arithmetic—on the principle that we have forgotten"; the "run" could be more properly called a sprint and its incalculable value can be faintly imagined from some of the following paragraphs which are abstracted in full, but with the strange mixture of capitals and small letters not indicated:

"8. The value of signs in artithmetic should be thoroughly appreciated. The student should learn to use them exclusively." "21. To multiply mixed numbers. Rule: Whole numbers × whole number. Upper digit × lower fraction. Lower digit × upper fraction. Fraction × fraction. Product of all added together." "25. Base × rate equal percentage. (Point off two places from the right.)" "35. The study of involution and evolution is one of necessity. The writer recommends that the student who is not familiar with it can best get results by securing the services of one who does understand it and can teach another." "50. The term aggregation means collection."

As Part II. is a "run through the primary of electricity," it is only fair to expect that the definitions of units should be of the "ampere is the flow of electricity produced by the pressure of one volt on a resistance of one ohm," and "volt is the pressure required to drive one ampere through one ohm resistance" order. A few of the luminous paragraphs in it cannot fail to be of interest, and we quote the following: "31. By right or left-hand armature is meant the relative position of the commutator to coils." "37. When an armature is at rest the ohm resistance is very low, usually less than one ohm." "41. The Wheatstone bridge system of measurement (of resistance) is based on the fall of tension of the current." "61. The voltage of a transformer must be proportional to the windings." "66. Magnets for retarding purposes * * * are first formed, then * * * magnetized, boiled and cooled the latter process, freeing them from loose magnetism. * * * The boiling and cooling causes an expansion and contraction causing the magnet to be freed from loose magnetism." "86. By efficiency of a meter is meant the comparative amount of energy it consumes in itself." "92. A short circuit on line when meter is in use will 'knock down' the magnet strength. This is due to magnetic circuit being increased in size so that magnets come within its range."

Perhaps the best portion of Part III. is its opening paragraph, which has already been cited. The reviewer will, however, not anticipate the pleasure of readers of the whole volume by giving more selections, but thinks that the ones that are abstracted above will in some measure recompense those who for lack of time or other reasons find themselves unable to peruse in full this truly remarkable treatise.

The Construction of a Gasoline Motor Vehicle. By C. C. Bramwell. New York: Emil Grossman & Bro. 149 pages, 86 illustrations. Price, $2.

This book comprises 14 chapters, and not the least of its recommendations is that it is written by a man whose experience with motor vehicle work has been gleaned from practical experimental design and construction.

In the first chapter the author devotes a few paragraphs to the operation of a four-cycle engine, and attacks the important problem of the proper mixing of gasoline and air. Then follow detailed descriptions of the action of numerous practical devices for this purpose. In the next chapter, beginning with generalization about combustion, he narrows the subject down to its application to combustion of gases in the internal combustion engine. Chapter IV. is devoted to hot-tube ignition, and incidentally discusses conditions which obtain in the cylinder of the engine at various parts of the stroke, especially at the critical points of compression and ignition. The next chapter is devoted to electric ignition both by primary and secondary

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spark, the principle of the electric circuit and its application to gas engine being ingeniously illustrated by hydraulic analogies.

Sources of electric current for internal combustion engine ignition are then discussed and illustrated by numerous diagrams. The subject of transmission devices occupies the next chapter and after carefully considering a number of different methods, the author concludes by recommending spur gearing or a sprocket and chain. In succeeding chapters he devotes a few words to the principles of power computation, and the multiplying effects of mechanisms, and then begins a description of a motor-vehicle motor of his own design which has been built and given satisfaction. In this design he goes into considerable detail and illustrates parts by scale drawings whenever necessary, and he intersperses his text with practical reasons for the construction adopted.

In chapter X. he introduces a few words with reference to the general design of a vehicle, in which he gives first place to the motor, second to transmission gear and controlling levers, and last of all to the body. Although the author recognizes that there is much to be done before the best form of motor vehicle can be determined upon, yet he recommends the standardization of many parts and devotes some paragraphs to that subject. In succeeding pages he continues the illustration of the construction of his motor vehicle and the design of its parts, and his description not only gives dimensions and materials, but goes into details of procedure on the lathe and planer. He then takes up the subject of mounting the motor in the frame, and discusses wheels, pivot hubs, and steering gear. The closing chapter is devoted to the subject of transmission gears, and describes, illustrates and discusses the manufacture of speed, changing and compensating gears, and friction clutches, concluding by illustrating the complete vehicle and the arrangement of the machinery.

It is easy to see on reading the book that the statements are the result of practical familiarity with the described design, and the book should be well received by those who wish to experiment with the construction of the gasoline vehicle for their own pleasure, and also by those who desire to become acquainted with the details of the mechanics and practical operation of such vehicles.

ELECTROMAGNETS. Their Design and Construction. By A. N. Mansfield, S. B. (Science Series.) New York: D. Van Nostrand Company. 155 pages, 36 illustrations. Price, 50 cents.

This little book is No. 64 of "Van Nostrand's Science Series," and takes the place of the old work of Du Moncel on the subject, bearing the same number. The publishers are to be congratulated on the change, for the old book was hopelesly behind the times, while this gives a presentation of the present state of the art so far as the limited space will allow.

All the fundamental principles are treated, including a short discussion of alternating currents and their effects upon electromagnets. There are tables giving the relation between U. S. metric systems, the properties of copper in wire in terms of B. & S. and B. W. gauges, temperature coefficients of resistance and weight of copper in 100 lbs. of insulated wire. These tables are not as full as could be wished, but it is perhaps not fair to expect very extensive ones in a book of this size.

In the third chapter there are some remarks about square and conical winding. By square winding is meant winding where any wire in one layer lies squarely on top of a wire in the layer below, while by conical winding is meant winding where any wire in one layer lies in the groove formed by two wires in the layer below. The book states "In practice something between these extreme cases is obtained." This statement is not quite satisfactory. Inasmuch as ordinary magnet winding consists of alternately superposed right and left-handed helices, it is impossible that a wire in one layer should lie either on a wire or in a groove between two wires in the layer below, all the way round the circumference. There must be two places in each convolution where the wires cross, and are therefore piled squarely, and two other places midway between these where the wires lie in the grooves, or conically. Obvious as is this fact, it is either imperfectly stated or altogether ignored by the majority of writers.

LES AUTOMOBILES ELECTRIQUES. By Gaston Sencier and A. Delasalle. With a preface by Charles Jeantaud. Paris: Vve. Ch. Dunod. 390 pages, 192 illustrations. Price, 15 francs.

This is an excellent book on the subject of which it treats, and we are not surprised that it has brought to the publisher a silver medal, awarded by the influential Automobile Club of France. The first chapter deals historically with the development of the automobile and includes a comparison between the cost of animal and electric traction. A table supplied by the Parisian Electric Vehicle Company puts the cost of operation of a public vehicle at $4.60 for a daily service of 24 to 30 miles, this including depreciation, service and all other items entering into complete cost. The depreciation in the case of the storage battery is given at 70 cents per day, and that of the pneumatic tires 60 cents per day.

The second chapter gives the definition and explanation of electrical and mechanical terms, and in the third chapter the primary battery is wisely disposed of in a few pages. The three following chapters—undoubtedly the most valuable in the book—deal with the storage battery. In one chapter the theory of the storage battery is given, another deals with their charging and the third describes in detail the various batteries used in European automobile service. Nineteen batteries are described and the full data of each are given. The most valuable part of this chapter is a table giving the results of tests of eight different makes of storage battery, made by the Automobile Club of France. The tests made by the Automobile Club are accepted as above suspicion, and as they are very thorough and made under the conditions of practice, the data here collected are of the greatest value.

A short chapter on telpherage motors is followed by a long one on automobile motors. Much of the matter here contained, such as that on the design of motors, appears to be out of place in a book of this character. A chapter is devoted to electric braking, another to gearing, one to controllers and methods of control, another to instrument equipment and one to vehicle bodies, wheels and tires. The penultimate chapter, and one of the longest in the book, contains descriptions of more than two score electric vehicles, among which are included several of American manufacture. The half-tone illustrations are very poor—as is usual in French publications; the descriptions, however, are concise and to the point. The final chapter is on combination gasoline and electrical vehicles, which the authors appears to consider have a bright feature. The work can be recommended to those interested in the automobile, the chapters on the storage battery and the descriptions of types of vehicles alone giving it great value.

THE "ENGINEERING" AND ELECTRIC TRACTION POCKET-BOOK. By Philip Dawson. Second edition, revised and enlarged. New York: John Wiley & Sons. 1305 pages, illustrated. Price, $4.

Extensive comment is perhaps unnecessary in reviewing a book which has reached its second edition, as has this. That fact alone shows it has met a demand and has a useful place in the world. This pocket-book is not claimed by its author to be anything more than a compilation from various authorities, of figures and tables on all matters pertaining in any way to electric traction. As such it is voluminous, and as complete as it appears possible to make it in the 1300 pages of a pocket-book. In many cases the source or authority from which the figures were obtained is given, and might well have been included in all cases.. There is considerable value in such a compilation. The data are presumably the best obtainable, and even though their correctness may be questionable in some instances, the fact that often a number of sets of figures are given applying to the same thing tends to reduce the probability of being led astray by individual errors. The wiring tables might well have been more carefully scrutinized and edited before being inserted.

It is impossible in a brief review of this kind to give more than a bare idea of the great number of subjects on which data are given. The data cover every engineering detail that goes into the make-up of an electric railway system. The figures include dimensions, costs and performance data. Being an English book, and primarily intended for English engineers, it gives, of course, much engineering data applicable only to English practice, though the compiler has drawn very extensively from American experience. Mr. Dawson has shown himself in the past to be a very able collector of data on American street railway practice, and in this pocket-book confirms that reputation. He gives, in fact, the most complete collection of engineering data on electric railway work to be found outside the pages of the technical journals, and has placed it in compact available form.

HOW TO BECOME A GOOD MECHANIC. By John Phin. New York: Industrial Publication Company. 68 pages. Price, 25 cents.

There are different opinions as to what constitutes a good mechanic, a very prevalent one being that manual skill in the use of

tools is all that is necessary. Our author, however, takes the broader view that a good mechanic is a man who has trained his mind as well as his hands. The contemporaneous tendency is toward euphemism in appellations, and any one who is familiar with all the subjects that the author recommends for study, would stand a very good chance of being dubbed engineer, even if he did not aspire to that title himself.

We agree with the author that a *good* mechanic ought to study all the subjects that he recommends, though the list includes algebra, geometry, trigonometry, physics and even chemistry. It is not expected or intended that he should be a mathematical luminary or an accomplished chemist, but it is growing to be almost a necessity that he should be able to interpret simple algebraic formulæ, and a sound, although elementary knowledge of chemistry, is a great help to him. We remember a discussion in a mechanical periodical a quarter of a century ago anent the tempering of tools, where one writer explained that the colors successively assumed by the steel in the tempering process, which are usually the sole criterion by which the workman knows when the proper temper has been reached, are due to thickening films of oxide. Another correspondent said that "oxides would better be kept out of the workshop," meaning that the workman would get along better if he were ignorant of chemistry. And yet a man who knows a little chemistry would know that a film of oil, by retarding the access of atmospheric oxygen to the surface of the steel, will make the color indications fallacious, which his rule-of-thumb shopmate does not know.

The author takes a straightforward, common-sense view of things, as in the other books that he has written. He recommends—thinks of it, oh, ye Heavisides and Perrys!—the study of Euclid, Euclid rather than Legendre, to working mechanics who toil through the day and study at night, and yet we are strongly inclined to his view. We hope that a great many mechanics and young people who intend to become mechanics will read this little book and profit by the very sound advice therein contained.

The Nash Gas Engine.

By James M. Cremer.

Among the large gas engines installed in the power court of the Machinery and Transportation Building, at the Pan-American Exposition, Buffalo, N. Y., which were notable for their size and their service in regularly operating the rotary pumps supplying water for the fountains about the grounds, the National Meter Company, of New York, exhibit a 125-hp Nash gas engine. This engine operated the pump that supplied the large volume of water for the electric tower and also three of the largest jets in the basin of fountains. In another part of the Machinery Building a 50-hp gas engine of the same make operated a 35-kw belt-driven dynamo, furnishing electric current for power purposes to numerous exhibitors who showed electrically-driven machinery in operation. In an accompanying illustration a 50-hp engine of the latter type is shown, but direct connected to a dynamo for electric lighting. Fig. 2 gives a cross sectional cut of the 125-hp engine above mentioned and shown in Fig. 1, which will serve for the 50-hp one as well, both being of the same general design, and both working on the four-cycle principle.

Referring to the cross section (Fig. 2) it will be noted that the engine is of the vertical, enclosed, self-oiling type. The cylinders are all separate castings, independent of each other, and are mounted on the crank case forming the upper part of frame which encloses the pistons, main bearings, connecting rods and other parts. All of these parts are lubricated by the oil contained in the base being dashed over them when the engine operates. Provision is made also for lubricating them independently by an automatic sight feed oiler.

The cylinders, which are so constructed as to be easily repaired or replaced, are water jacketed on the sides, heads and valve cases, and are drained at the lowest point. Trunk pistons, single-acting, of simple form are used, and since these act as cross-heads as well they are made of proportionately great length to diameter. The crank shaft is in one piece of forged open hearth steel, and runs in adjustable bronze boxes, so arranged that each crank has a bearing on each side. The connecting rods have crank ends of the marine type, with adjustable bronze boxes; the end connected to the trunk piston is formed into a solid eye and fitted with a renewable bronze bushing.

It will be noted in the cuts that all the valves and the whole valve motion are conveniently located on the working side of engine. A single cam-shaft driven by a pair of spur gears operates all the valves through levers and rollers. Each cylinder has its own admission, gas and exhaust valves, the admission valve being shown with its cam, roller and lever, and the gas valve with a pawl, engaging a toe carried on the admission valve stem. Either both of these valves open together to admit a charge for the power stroke, or else the governor acts to disconnect the pawl, when the gas valve remains closed and

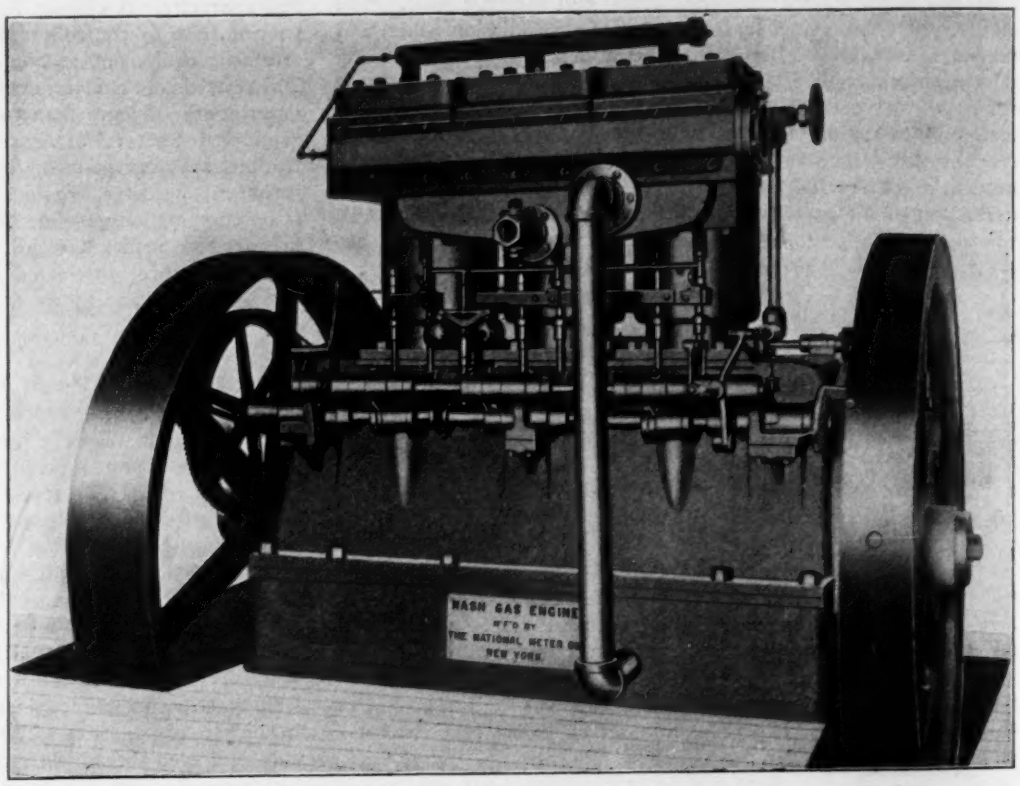


FIG. 1.—125-HP NASH GAS ENGINE.

no charge enters, until standard speed is restored. Whenever a charge is missed, the admission valve still permits air to enter, which is compressed, expanded and exhausted, thereby cooling the cylinder and cleaning it of any remaining products of combustion.

The exhaust valve is located immediately behind the admission valve, the exhaust connection with its flange appearing at the upper right-hand of the cylinder. Immediately below this is the flanges opening by which gas enters the mixing chamber, and surrounding the upper part of the gas connection is an annular opening through which air passes and is mixed with the entering gas for a charge.

The valves have long stems, carefully fitted to bearings, and guided at the top and bottom, thus securing an accurate seating without any side springing to occasion wear and leakage. Electric igniters of the make-and-break type are attached to each cylinder, as shown in the cut, being operated by separate eccentrics carried on a shaft located on the side opposite to the valve motion, and driven from the cam shaft by means of a cross shaft and two pairs of miter gears. The igniters are independent of each other, and are provided with

means of adjustment to accurately time the ignition, as desired, without stopping the engine.

A special form of fly ball governor, driven by bevel gearing from the cam shaft is used with these engines. It operates by the method of missed ignitions and secures a remarkable steady speed, even under wide variations in the load. The governor is very sensitive, and more especially so because it does not operate the gas valves directly, but simply indicates by the position of the lever to which it is connected, whether or not the lifting pawl shall act to open the gas valves or keep them closed as demanded by the load upon the engine. Each cylinder has its own gas valves, and is governed independently of the others.

The 50-hp engine illustrated has three cylinders, each 9 inches diameter and 11 inches stroke, the speed being 270 r. p. m. The 125-hp engine has three cylinders, each 13½ inches diameter and 16 inches stroke, opening at speed of 225 r. p. m. It will be observed that these speeds are quite moderate, although the vertical type of engine would safely permit considerably higher ones.

Each of the engines is provided with a suitable self-starting device, operated by compressed air, since they are too large to be conveniently started by hand. The air starter consists essentially of an air compressor, an air reservoir and suitable valve mechanism to operate one of the cylinders by compressed air. The action is as follows: A single

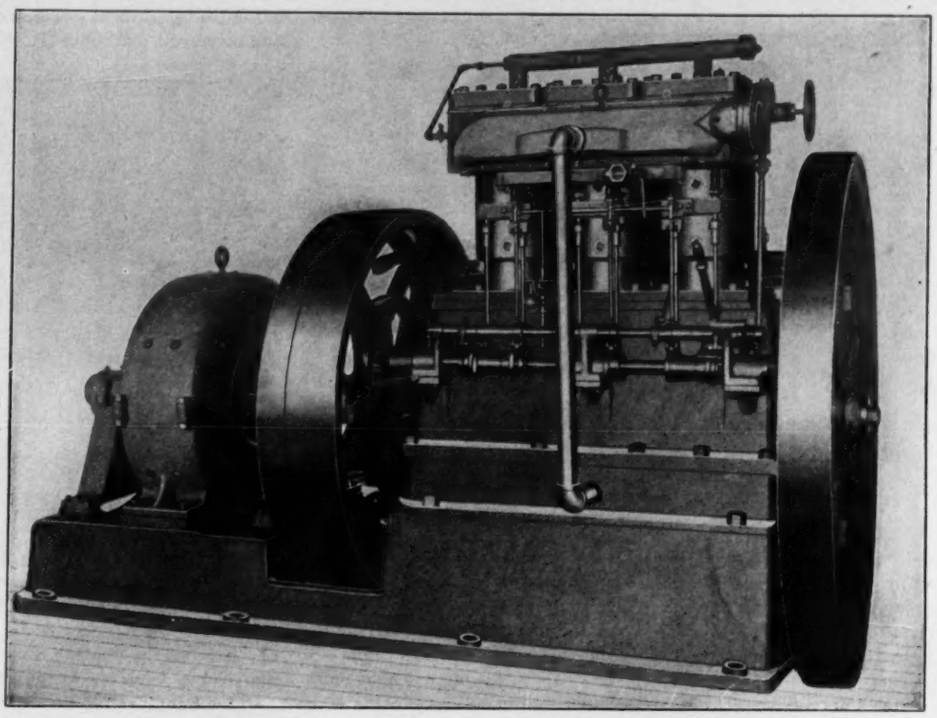


FIG. 3.—50-HP NASH GAS ENGINE WITH GENERATOR.

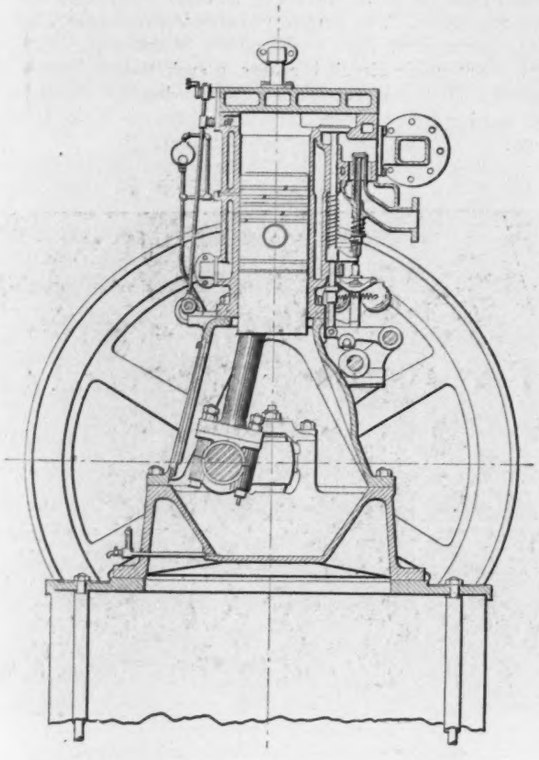


FIG. 2.—CROSS-SECTION OF GAS ENGINE.

movement of the starting lever throws into action supplementary cams, so that the right-hand cylinder operates as a single-acting compressed air engine, while the other two are placed in position ready to start up with gas. As soon as speed is attained, by means of the first cylinder, and ignitions occur in the other two cylinders, the starting lever is moved back to its normal position, the air-starting mechanism is disconnected, and the machine operates as a gas engine. The whole device is simplicity itself, and very satisfactory in operation.

The Electrical Equipment of the Largest White Goods Factory in the World.

The Defender Manufacturing Company, the largest manufacturers of sheets and pillow-cases in the United States, has recently installed a complete electric power equipment in its factory building on Avenue C, between Thirteenth and Fourteenth Street, New York. The building (Fig 1) is six stories high, inclusive of basement, which is 3 ft.

FIG. 1.—FACTORY EQUIPPED WHOLLY WITH ELECTRIC POWER.

below the street surface. The raw material, as it comes from the mills, is delivered in the receiving department, located in the basement, whence elevators deliver the goods to the cutting department for the underwear and the tearing department for the sheets and pillow-cases on the third floor.

After passing through the stamping department, the material is sent to the operating room on the fifth floor. At the north end is the sheet department (Fig. 6), with hundreds of sewing machines making a hum like a gigantic beehive. No belts or shafts are seen overhead, each set of machines being driven by a 2-hp C & C motor making 500 r. p. m., and being direct connected to the common shaft. There are in all 22 tables, each equipped with a motor at the one end resting

on the floor (Fig. 4), and there are 20 to 25 machines on each table. The company thought it advisable to sub-divide the power in this way so that any one table might be shut down in case the type of machines mounted thereon were not required. The motors are cov-

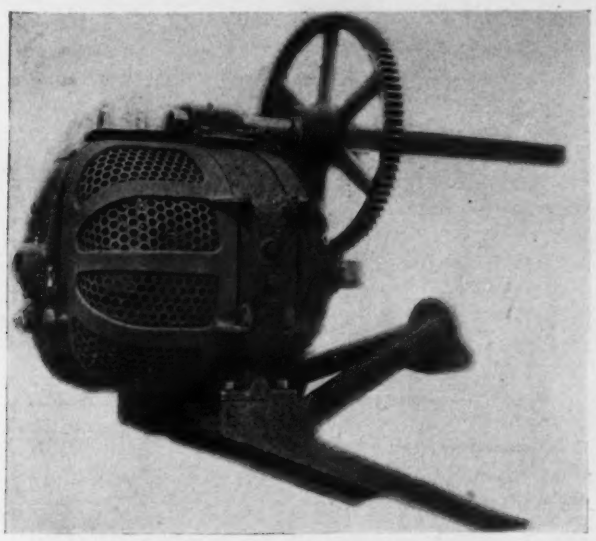


FIG. 2.—SINGLE REDUCTION MANGLE MOTOR.

ered by ornamental boxes which rest on wooden tracks, so that they can be pulled out for convenience of cleaning and inspecting the motors. At the south end of this floor is the muslin underwear operating department, and a thoroughly equipped machine shop, where all repairing is done, is also located on this floor. All the machine tools in this shop are driven by a C & C electric motor.

Throughout the entire building a system of chutes has been installed for the handy conveyance of goods from floor to floor. Two of these chutes extend from the fifth to the second floor, the percentage of its grade being sufficient to cause the goods to slide downward. At the southern end of the fourth floor is the lace and embroidery stockroom. On this floor are located the lace running, tucking and hemstitching departments for which purpose several high grade and specially constructed sewing machines are employed, some of which contain five needles operating simultaneously. These machines are mounted on tables, and are driven on a common shaft by a 2-hp C & C motor.

After the completed work has passed through the inspecting department, it is then ready for the final operation of ironing, and is sent to the finishing room. Here, on the second floor, girls stand on each side of the mangles or ironing machines (Fig. 5), passing sheets and

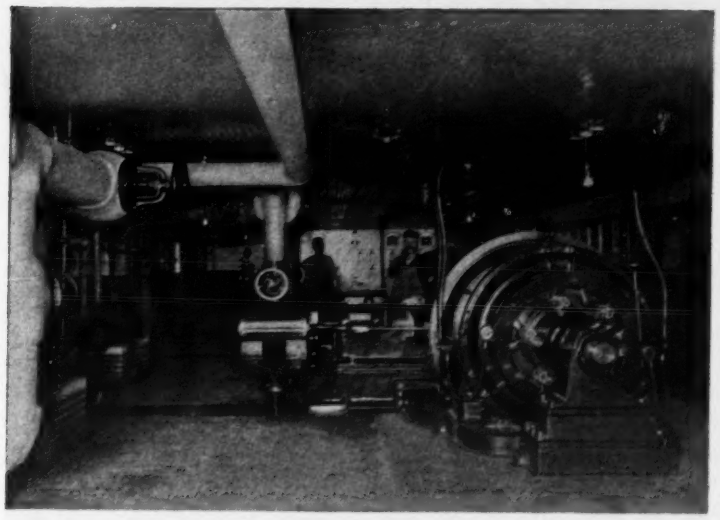


FIG. 3.—DYNAMO ROOM.

pillow-cases through the steam heated, revolving cylinders. A sheet is started evenly on one side of the machine, coming out on the other, beautifully ironed, in less than half a minute. The mangles, of which there are six, are equipped with 108 inch rollers, and are driven by C & C motors (Fig. 2). The latter are direct connected, the single reduction method being applied for the first time in this installation, where it has given entire satisfaction. The muslin underwear is ironed by handirons, which are heated by gas at present, but will probably soon be electrically heated.

After the ironing operation, all the finished material is neatly labeled, wrapped and packed ready for shipment. By means of a link-belt conveyor, manufactured by the Link Belt Engineering Company,

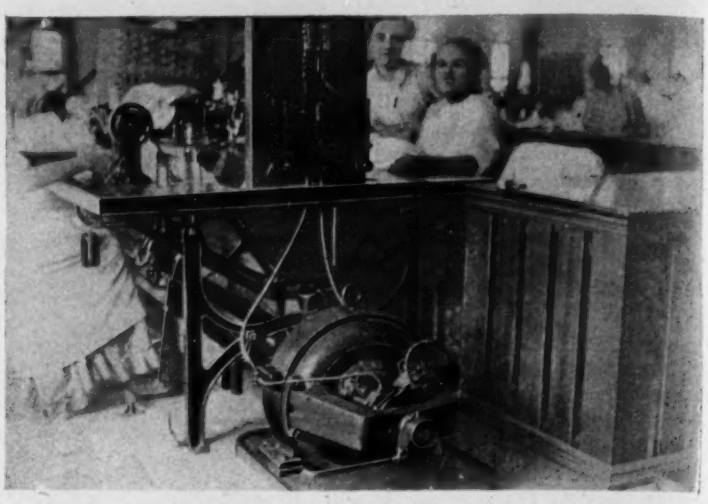


FIG. 4.—END OF SEWING MACHINE TABLE.

the finished goods are conveyed from the second floor to the shipping department on the first floor, where they are automatically unloaded. This conveyor is operated by a 2-hp C & C motor. By means of an apron conveyor composed of slats, and 50 ft. in length, the finished material is conveyed to the huge stockroom on the first floor.

A well equipped dynamo room generates current for the 33 C & C motors, 60 enclosed arc lamp and 750 incandescent lamps scattered through the building. In the dynamo room (Fig. 3), which has a tiled brick flooring, are two 80-kw C & C Electric Company's 250-volt direct-current generators, direct connected to two 125-hp Harrisburg standard engines, the speed of which is 275 r. p. m. These units are almost noiseless in their operation, and are remarkable for their accurate regulation. The marble switchboard measures 6 by 12 ft. On it are mounted 12 light and 7 power switches, 2 main dynamo switches, 2 automatic circuit breakers, 2 each Weston volt and ammeters and 1 Weston direct-reading ground detector. This board is one of the handsomest ever turned out by the C & C Electric Company.

The two boilers were furnished by Sam Smith & Sons, Paterson,

FIG. 5.—SECTION OF FINISHING DEPARTMENT.

N. J. They carry a pressure of 90 lbs., and have a capacity of 125 horse-power each. A narrow track coal and ash conveyor leads from the boiler room to a point beneath the sidewalk. The exhaust steam heating system throughout the building was installed by John D. Clark. The other auxiliary apparatus consists of a feed pump, extractor and feed-water heater. The building was wired by the Elec-

tric Construction & Supply Company, New York. One set of two-wire lighting mains are run to each floor of the old and new buildings, and one set of power mains to the first, second, fourth and fifth floors of the old building, and to the second, fourth and fifth floors of the new building. A panel board serves as a center of distribution on each floor of the two buildings. All mains are run in Electroduct

FIG. 6.—ONE OF THE FOUR OPERATING ROOMS.

conduit. There are in all 104 branch circuits emanating from the 13 panel boards.

In concluding, words of praise are due to the general manager, Howard B. Keppel, who designed and supervised the construction of this up-to-date establishment, and to whom we are indebted for the above interesting details.

An "All-Switch" Portable Test Set.

In our issue of Sept. 14 was illustrated a new type of test set made by Elmer G. Willyoung, New York. The same manufacturer has just announced another new set, a sort of companion to the other. This latest set is known as the "Universal," and is shown in the illus-

PORTABLE TESTING SET.

tration herewith. It is the exact equivalent of the other in practically every particular, save that the rheostat and bridge coils are regulated by switches instead of by plugs. In laying out the rheostat coils, the "decade" plan is used, there being four groups of coils, viz., 10 units, 10 tens, 10 hundreds and 10 thousands, instead of the 1, 2, 3, 4, 10, 20, 30, 40, etc., scheme of the other set. The bridge arms are 10, 100, 1000 and 10,000 on each side. There is a special switch permitting use of an outside galvanometer instead of the sensitive D'Arsonval. There is also a switch for the Varley and Murray loop tests, and a switch for permanently closing either the galvanometer or battery circuit (often useful in special tests). In the left-hand upper corner of the illustration is seen the galvanometer shunt box which is interchangeably built so that it may or may not be purchased with the set in the first instance as desired. In the battery there are eight cells, and provision is made for attaching any number of extra outside cells for special tests at any time.

The switches are of a special design, and have been in experimental use for nearly two years. Each switch is made of a number of leaves of phosphor-bronze which are turned over at the end so as to make "end-on" contacts with the studs. Each leaf of every switch is entirely independent of all the other leaves, so that each stud has four separate contacts in multiple.

Owing to the decade plan being used, this set is necessarily larger and heavier than the earlier one, measuring $13\frac{1}{2} \times 8 \times 5\frac{3}{4}$ inches deep over all, and weighing 11 lbs. The set makes all the tests for resistance, insulation by the direct deflection method, self-induction, location of faults by the Murray and the Varley loop method, checking ammeters and voltmeters, internal resistance of batteries, etc., etc. It should be mentioned that there is absolutely no loose part to become detached and mislaid. Even the binding post tops are spun in so that they cannot fall out.

The North Bay Power House at the Pan-American.

Occupying one of the prettiest sites on the Pan-American grounds, on the west side of North Bay, stood the neat little power house of the E. G. Bernard Company, of Troy, N. Y., where was located the motor generator which received the 500-volt current from a power

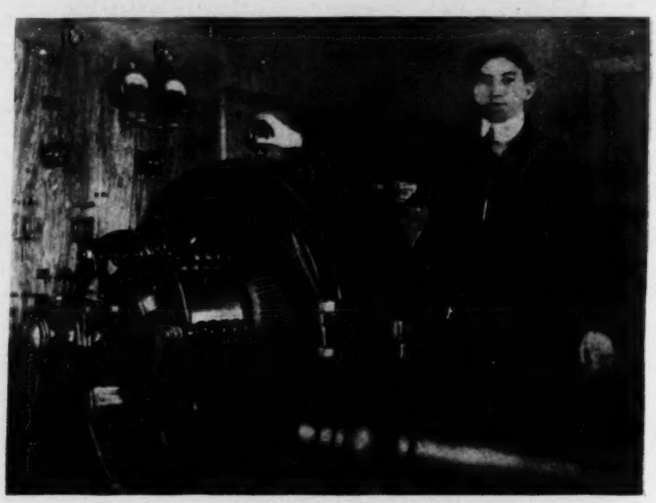


FIG. 1.—MOTOR-GENERATING SET.

house on the grounds, transforming it to a 125-volt current for use in illuminating the electric fountain located in the center of the bay.

Fig. 1 shows the motor generating set, with its attendant. In Fig. 2 are shown the three panels and starting rheostat for this set. The motor starting box, shown in the left corner of the illustration, is one of the special features of this plant. It is 24 inches wide, 32 inches high, and 12 inches deep. The main arm of the rheostat contains heavy copper leaf contacts. These, when the arm reaches its upper position, making contact with the two terminals shown, short circuit the resistance box.

Upon the first panel of the switchboard for the large motor are a direct-current ammeter, a voltmeter, the main switch and a Ward Leonard no-voltage and overload circuit-breaker. The no-voltage part of the circuit breaker opens when the supply of current is for any reason cut off from the motor. The overload part, like any similar circuit breaker, opens from excessive current. Current passes through the no-voltage coils while the current is on the line, and its armature is consequently held up; but the moment the circuit is opened, the armature drops, releasing the breaker. The overload breaker opens by drawing up its armature from excessive current.

A rheostat wheel and distributing board switches occupy the dis-

tributing panel, while the third panel is for the generator, with a voltmeter reading from 0 to 150 and an ammeter reading from 0 to 1000, and rheostat F. B. 110. There is also an 800 ampere double-throw single pole switch fused. The switchboard frame is 3-inch T iron, and its supports 3-inch channel iron. Vermont marble is used throughout.

It is an interesting fact that the bus-bars on these panels are formed of aluminum, which has several advantages over copper for use in this work. One is, that while copper bars will often crack in forming, especially if bent when cold, the aluminum can be bent cold without fracturing, the surface barely roughening. Special work can thus be

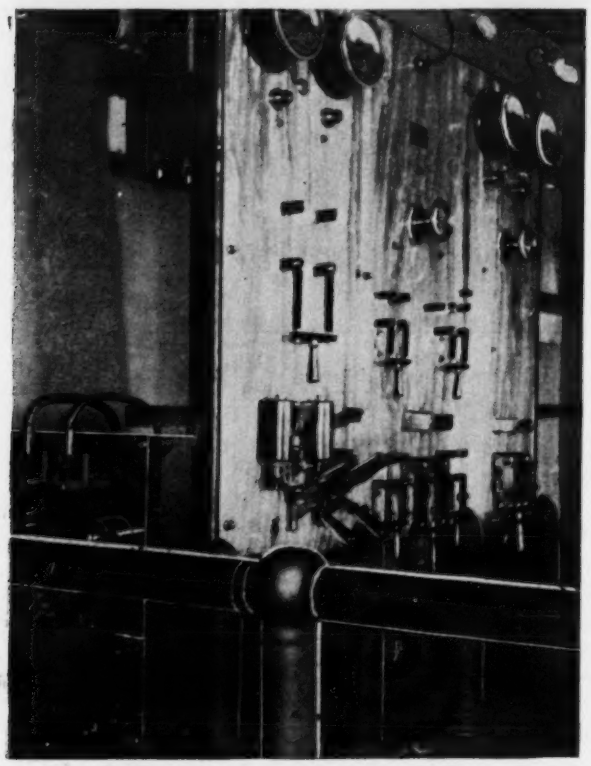


FIG. 2.—SWITCHBOARD WITH ALUMINUM BUS-BARS.

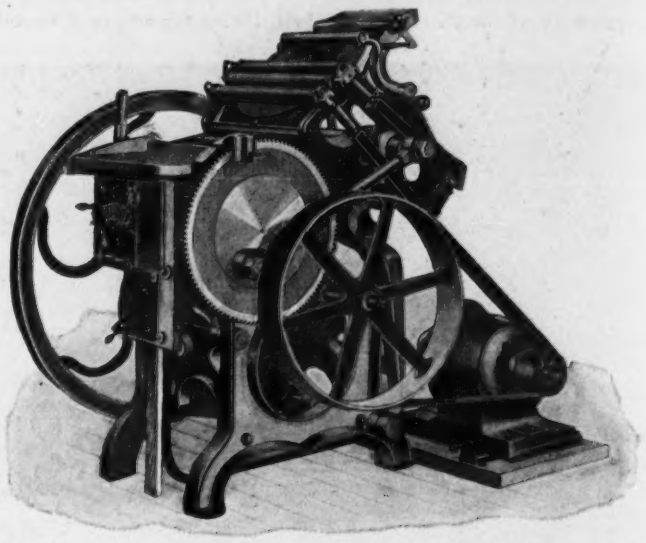
gotten out in very short order. Short bends can be made, and in various shapes, with comparatively no trouble. Should there be any doubt about the continuity of the grain, heating the bar to a low temperature will at once restore it. With the method of soldering employed by the E. G. Bernard Company, there is no trouble from this source.

A smaller motor generator supplies current for the arc and incandescent lamps about the building, and has a separate switchboard for its control.

The E. G. Bernard Company has also other motors on the Exposition grounds, one operating the grate bars for the Eames grate bar exhibit, and two at the Vermont Farming Machine Company's exhibit

Motor-Driven Job Presses.

Printing offices have been a field peculiarly favorable to electric power, and presses were among the first mechanisms to be operated by the electric motor. Possibly one of the reasons has been that little or no change in any of the machines was required in order to adapt them to the new conditions, and this fact is illustrated in the little combination shown herewith, in which is seen one of seven 12 by 18 job presses installed by the Thompson Electric Works, of 350 Dearborn Street, Chicago, for the Fac-Simile Company in the Unity Building, that city. The motor is of the Thompson iron-clad type, moderate speed. The ¼-horse-power at 1500 r. p. m. weighs 100 lbs. The 10-horse-power at 120 r. p. m. weighs 900 lbs. The features of construction are sound. The magnetic frame is one circular ring without joints. In the compound-wound machines the shunt and series coils are separately wound. The bearings are supported by brackets bolted to each end of the magnetic frame, and are of the self-oiling type, and made of babbitt. They have large surfaces to insure cool running and are lubricated automatically from oil wells and revolving rings. The oil wells are absolutely tight so as to prevent leakage, no matter what the position of the motor. The end brackets supporting the bearings are so placed that the machines may be quickly arranged to operate in an upright, inverted or semi-in-



ELECTRICALLY-DRIVEN PRINTING PRESS.

verted position, that is, may be set on the floor or bolted to the ceiling or wall. All parts in the motors have a liberal allowance of metal, and are interchangeable.

Novel Methods of Electric Drive.

The loss of power due to the use of long lines of main shafting and countershafting, the use of pulleys and belts, and the idle running of large portions of the power transmission system, has been mainly responsible for the promptitude with which the electric motor has been welcomed in mills, factories, mines, etc. It has found special favor when instead of being attached to a line of shaft, it can be closely associated with the driven machine or tool, and it is in this method of direct driving that some of the most notable economic triumphs of the electric motor have been realized. No little special ingenuity and engineering skill in this department of direct electric driving has been displayed by the Northern Electric Manufacturing Company, of Madison, Wis., and the smaller examples we present of their work here do not begin to do justice to the wide range of size, work, etc., in which Northern motors have supported the strongest claims ever made for the efficiency and applicability of electric power.

FIG. 1.—VERTICAL MOTOR.

In Fig. 3 is shown a Northern Electric grinder complete, arranged for variable speed. The motors in these and in the analogous buffing outfits are of the dust-proof type, mounted on special stands which contain the starting and speed regulating rheostats. They are self-oiling, self-aligning and run smoothly and cool. They are wired ready for use before shipment.

In Fig. 1 is illustrated an application of the Northern Electric vertical motor, of the open type, direct connected by flexible coupling with a propeller pump. Installations of this character have been carried up to 90 horse-power. In Fig. 2 is shown a 2-hp motor driving a portable drilling outfit from a flexible shaft. These outfits are useful in a great many places, and have been found specially convenient in the Government navy yards in the execution of repairs. The motor swiveling on a ball-bearing base can be operated at any vertical or horizontal angle.

Quite aside from this and their heavy work, running up to motors

of the largest capacity, the Northern Company has supplied motors for electric launch work, and its latest catalogue shows two in service which have been equipped each with a 4-hp motor of 570 r. p.

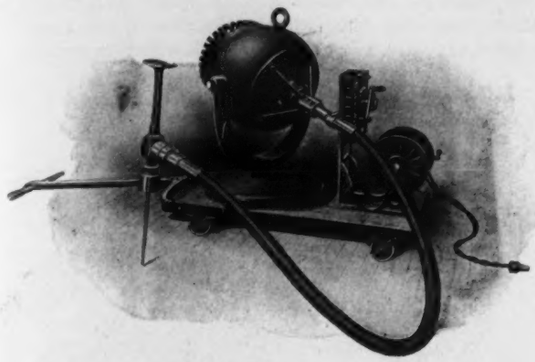


FIG. 2.—PORTABLE DRILL.

m., operated with a Northern reversible speed controller. The boats are 30 ft. in length, and are equipped with sets of 44 Willard storage batteries made by Sipe & Sigler.

Motor-Driven Matrix Machine.

An interesting motor combination is that shown in the accompanying cut, which illustrates a matrix machine direct driven by a Roth motor. These motors are of the enclosable or protected type of machine, all the vital parts of the machines being inside of the frame. The armatures are built of laminated iron, slotted to receive the form-wound conductors. The field frame is novel, in that the entire frame and bearing supports are cast in one piece, making a very substantial and rigid form. The poles are of cast steel, of round section, and are provided with pole shoes. These poles are deeply embedded into the yoke, by a special casting process, and are held in place by a large screw, being readily removable for the purpose of taking off or putting on the field coils.

The bore for the armature and for the bearing boxes is of one size, all the boring being done at one setting. The boxes are supported so as to be always concentric with the bore of the poles. The boxes are movable shaftwise to give the proper amount of end play, and also movable radially to keep the oil well in a proper position for wall or ceiling suspension.

Another feature of these machines is their symmetrical outside form, this being obtained by shifting the poles to one side of the frame, and by the use of a peculiar form of pole shoe, which gives a center line for the armature core considerably away from the center line of the frame, giving the proper room for the commutator. These machines are wound for the standard voltages at standard speeds, and also at special speeds for the various uses to which motors are put.

The illustration shows, as noted, the application of one of the motors to a stereotype matrix rolling machine. The combination of motor and machine presents some features not commonly found in power applications. The matrix rolling machine is designed for and successfully takes the place of a former method of making a matrix, from which to cast a stereotype plate. This method necessitated the beating of the paper in with a hand brush. On this machine the "form" of type and cuts is placed upon the bed of the machine and the wet matrix paper is put thereon. On top of this is placed a felt blanket about 3/8-inch thick. The machine is then started up and this is rolled forward and back, which effects the result formerly secured by hand. The construction of this machine is such that its movement must be under absolute control by the operator at any point, and stops automatically at each end.

To all large newspapers, the saving of a few minutes is of great importance. This machine does the work in about one-fourth of the time formerly taken by the old hand process. As before stated, the running of the machine must be under the absolute control of the operator. The motor is compound-wound, and also reversible, and made for quick starting. In operation, the handle or rod, shown on the machine, is pulled or pushed according to which direction the table of machine is to move. This throws in the reverse switch, thus completing the circuit through the automatic starter, which is adjusted for quick acceleration of speed. The table then moves until a stop automatically trips off the reverse switch and also sets the brake on the matrix machine. It is necessary to start the machine by hand, but it stops automatically at each end of its movement, unless stopped before by hand.

The shunt fields of the motor are energized when the main switch is on. The motor shown is of 3 horse-power, and runs at a speed of 900 r. p. m. It is provided with a rawhide pinion for noiseless operation. These motors are built by Roth Brothers & Co., of Chicago.

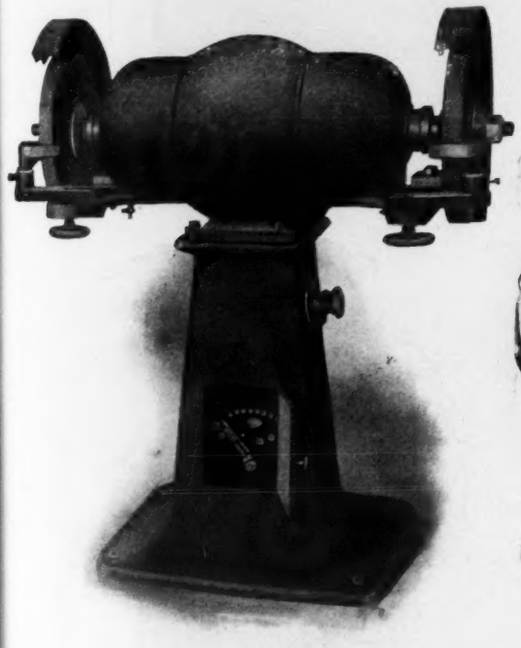
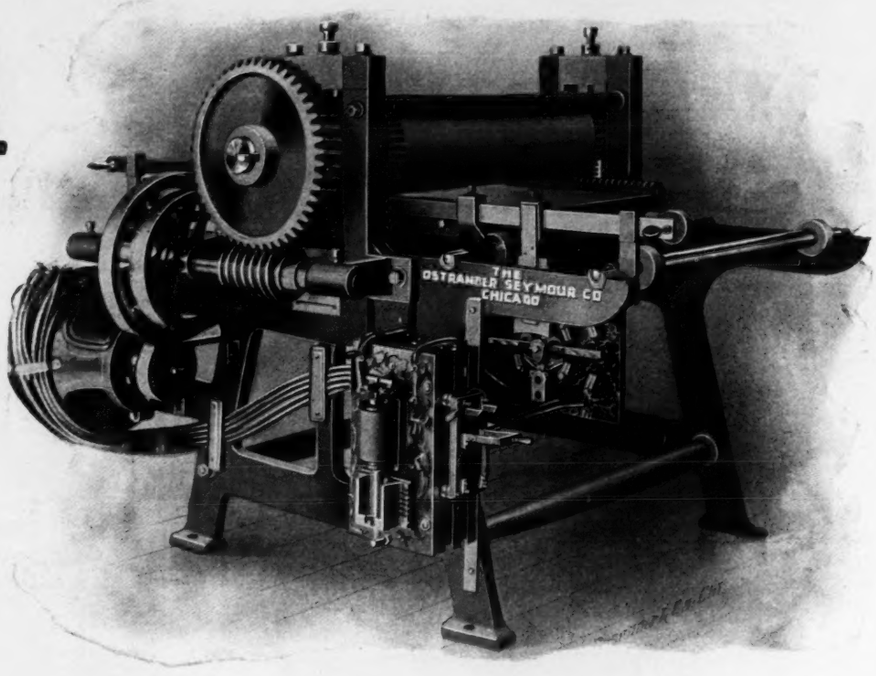


FIG. 3.—ELECTRIC GRINDER.



ELECTRICALLY-DRIVEN MATRIX MACHINE.

Portable and Desk Lamps.

McLeod & Ward, the patentees and manufacturers of the Kinsman desk lamp specialties, 27 Thames Street, New York City, have introduced a number of modifications and improvements in this line of work, one or two of which are here illustrated. The Kinsman portable for use on pianos, desks, etc., shown in Fig. 1, can, of course, be used in any place where an elevated fixture of the kind is required. It is made in polished brass, nickel plate, old brass or oxidized copper. In Fig. 2 is shown the Ward orchestra lamp, of similar finish. It is used for music stands, and can be readily clamped to the rack. It is adjustable as to the size of the opening, which controls the quantity of light. The cylinder may also be moved in a rotary direction to throw the light as desired. Of the same type is the Ward picture lamp, now being extensively used to light fine oil paintings, and which can be made with one, two or more lamps in accordance with the size of the canvas. The supporting arm is adjustable and can be easily fastened to the picture frame.

FIG. 1.—PIANO PORTABLE.

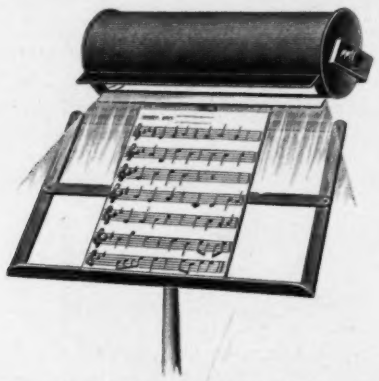


FIG. 2.—MUSIC STAND LAMP.

Fig. 3 shows the Ward pulpit lamp, which, in addition to the regular finishes, is made also in green enamel. It can be neatly arranged on a pulpit so as to throw the light on book or manuscript without allowing any stray light to escape beyond the regulated field of vision of the speaker. Its method of affixing to the desk or lectern is shown.

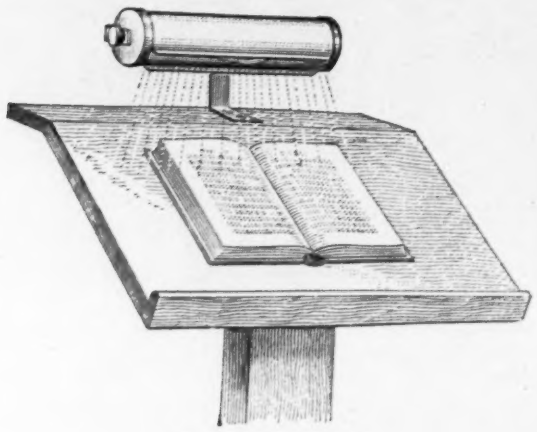


FIG. 3.—PULPIT LAMP.

Bullock Motors.

A number of recent power installations of an interesting nature have been made by the Bullock Electric Mfg. Company, of Cincinnati, Ohio, which has paid attention to direct driving and to securing speed variation. The range of work is well exemplified in the accompanying cuts. Fig. 1 shows a Brown & Sharp grindstone outfit driven by a Bullock motor, forming an extremely compact outfit, in which the motor is thoroughly protected against ill usage, moisture and dust. In Figs. 2 and 3 are shown a group of Fitchburg engine

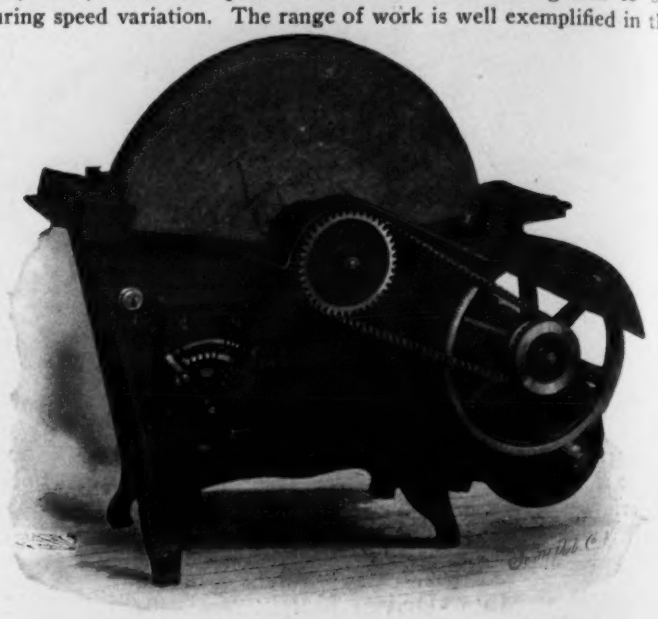


FIG. 1.—GRINDSTONE OUTFIT.

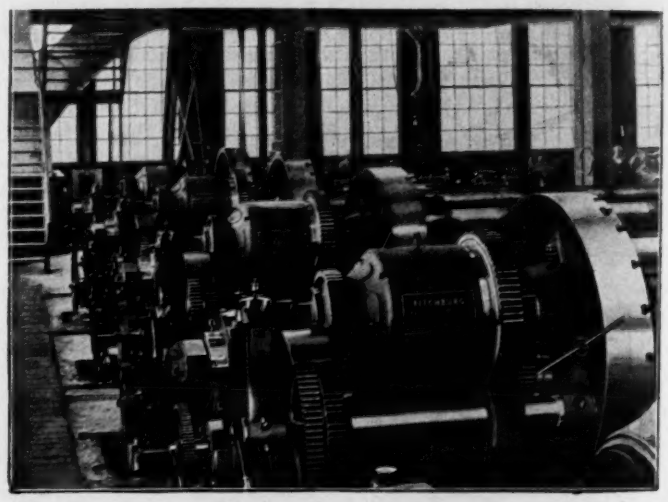


FIG. 2.—ELECTRICALLY-DRIVEN ENGINE LATHES.

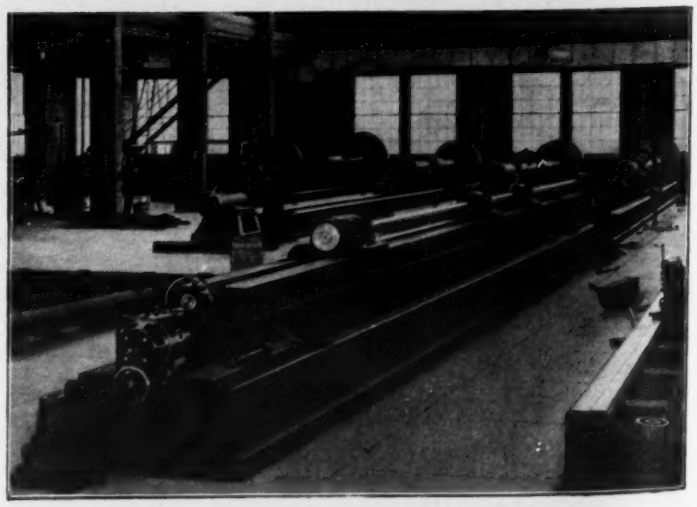
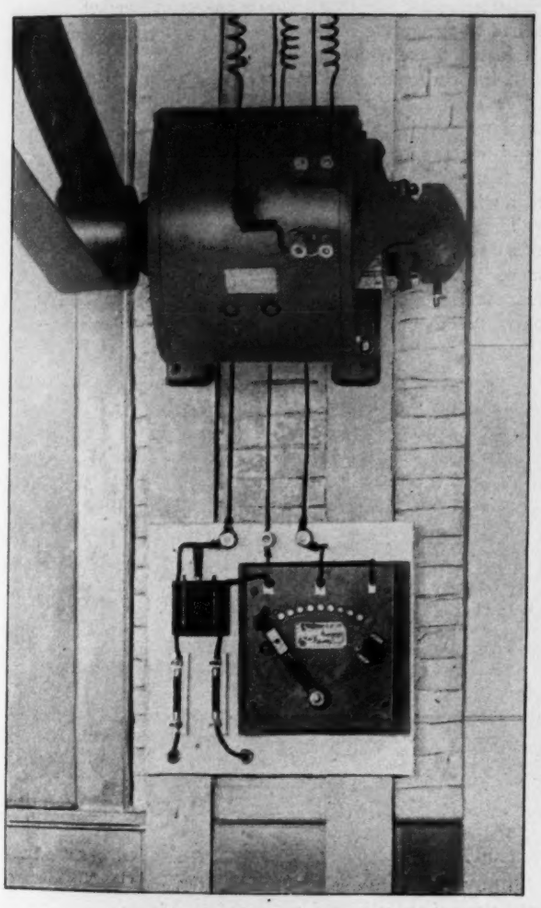


FIG. 3.—ELECTRICALLY-DRIVEN ENGINE LATHES.

lathes installed at the shops of the Fore River Engine Company, Quincy, Mass. They are driven by Bullock motors on the head and tail stocks. The largest lathes have beds 110 ft. long. The motors are controlled by the Bullock multiple voltage system affording six speeds in either direction without armature or field resistance.

Wall Suspension Motor in Rochester, N. Y. Mechanics' Institute.

In the manual training department of the Rochester, N. Y., Athenaeum and Mechanics' Institute, a wall suspension motor has recently been installed by the Rochester Electric Motor Company. It is their regular motor, with the end plates swung round for wall suspension. It was installed in the wood-turning section, belting direct to the line shaft, under guarantee to deliver 7½ horse-power on the belt continuously, and to stand 50 per cent overload for one-half hour, with a rise of temperature, above the surrounding air, not to exceed 110 F. The motor is shunt wound for 900 r. p. m. constant speed at 230 volts, and is a four-brush multipolar, having an efficiency of 87 per cent at full load and 85 per cent at 50 per cent overload. The magnetic frame is cast, and the poles and armature are built up of thin sheet steel, which is so firmly pressed together as to make practically a solid, uniform mass of metal.



WALL SUSPENSION MOTOR.

The poles are bolted to the frame in such a way as to have a perfect fit, and leave it possible to remove a pole and coil without removing the armature. The armature is provided with both radial and longitudinal ventilating ducts. The windings are machine. The commutator bars are held by a double clamp so as to render it impossible to get either a high or a low bar.

Both the brush surface and the wearing depth are of liberal design. The brush holder is of the well-known reaction type, and needs no adjustment. Still, if desirable, by the loosening of one set screw, the brushes may be moved backward or forward simultaneously. The bearings are boxes of the ball and socket type, and provided with ring oilers.

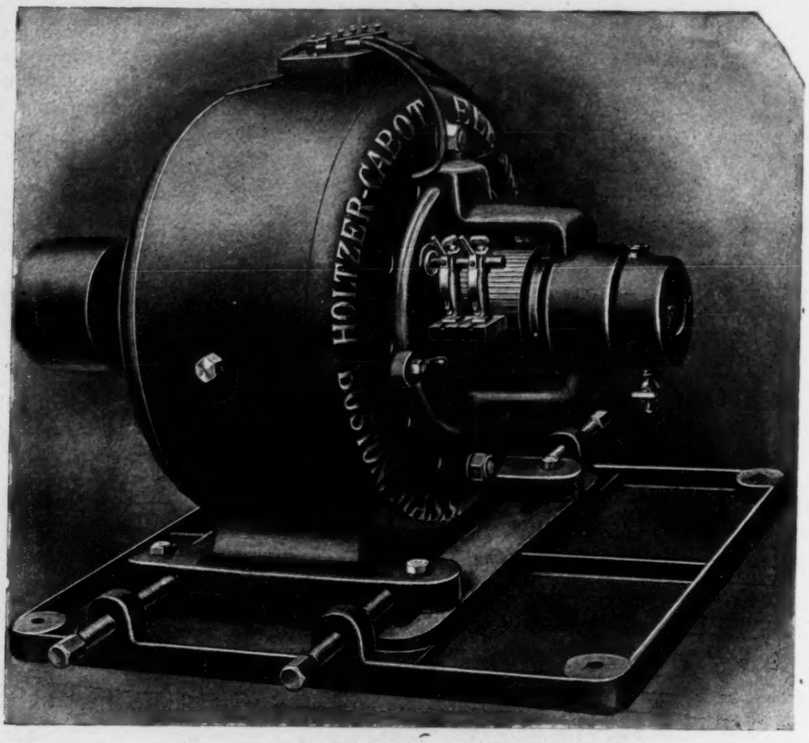
New Universal Enclosed Motors.

The Holtzer-Cabot Electric Company, of Boston, Mass., has recently placed upon the market a line of universal enclosed motors, designed more particularly to meet various special requirements. They range in size from 1-6 horse-power to 10 horse-power, are simple and compact, and easily adaptable to wall or ceiling suspension. This is accomplished by giving the end cases which hold the ring a quarter or half turn, as the case may be. Up to and including 3 horse-power the machines are bipolar, and above that multipolar.

The field frame, which is of cast iron, is circular in shape, as shown in the accompanying cuts. Thus the magnetic circuits are of equal cross-section and equal length, therefore necessarily of equal reluctance, so that there is no unbalancing of the armature circuits.

In the enclosed motor there is, of course, little or no chance for radiation from the inner portions of the machine. It is therefore of great importance that all electrical and magnetic losses be reduced to a minimum. Both armature core and pole pieces are therefore carefully laminated to break up metallic continuity and to reduce the iron losses, as much as possible. By careful copper allowances in the conducting portions of the machines, the losses due to heating effects of the current are kept well within the limits of safety. The manufacturers claim an unusually low temperature elevation for machines of this type.

The poles fit into curved seats in the field ring where they are held by bolts extending through the ring. They are built up of laminations of soft sheet steel, and are provided with projections or shoes of such shape as to form a properly shaded magnetic fringe. Shifting of the



UNIVERSAL ENCLOSED MOTOR.

diameter of commutation is done away with and sparkless commutation secured through all changes of load.

The armature is also built up of laminations of annealed steel. It is of slotted type and the coils are held in place and protected from mechanical injury by maple wedges which run the entire length of the slot. It will be noted that the rocker arm is entirely dispensed with, and the brushes are held by a ring which fits snugly into a machined seat in the front end case. This may be moved in either direction to place the brushes at the proper commutating point, being then clamped by two special screws.

The terminal board is placed conveniently on top of the machine, two special bosses being provided for that purpose. The connections are all made on the inside, and are thus entirely out of the way, although they may be reached easily if necessary by slipping off the

front end case. The commutator and brushes may be cleaned or adjusted without danger or inconvenience to the attendant. The brush holders of the larger sizes are of the standard radial type, and are the same as used on the Holtzer-Cabot multipolar machines of the open frame type. The brushes themselves are clamped solidly to a machined surface on the holders which are reinforced by a number of flexible copper strips, so that no springs or sliding contacts are depended on to carry current. In the smaller sizes, where the motors are likely to be run a considerable length of time without attention, a box brush holder is used with a parallel feed, which will allow a long period of wear without any attention.

These motors may be readily modified to meet almost all the conditions that arise in engineering practice. For buffing, grinding or polishing, or in cases where the motor is apt to be exposed to an unusual amount of dust and dirt, a housing is fitted over the commutator, completely enclosing the motor. For electric launches, where minimum weight is desired, the non-magnetic or non-conducting portions of the machine are made of aluminum. The motors are readily adapted for direct connection to fans, blowers, presses, etc. The manufacturers claim unusually high efficiency for units of this size, varying from 63 per cent in the smallest to 89 per cent in the larger sizes, with a relatively high efficiency on light loads.

The Mayer Dynamos and Motors.

On this page are illustrated some new dynamos and motors now being built by the Maxwell M. Mayer Electric Company, of New York. Their chief feature of construction is a magnet frame consisting of a

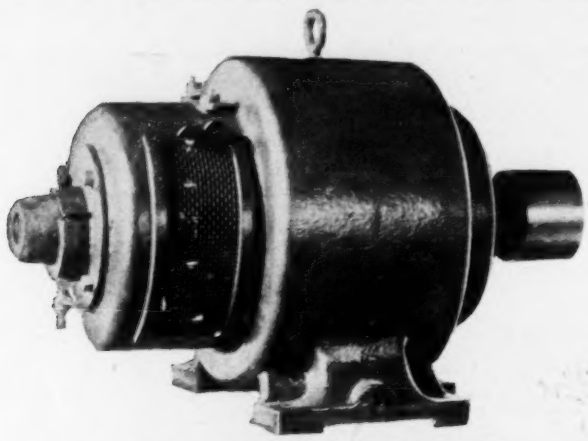


FIG. 1.—DYNAMO AND MOTOR.

cast iron ring having steel magnet cores cast into the ring. The end faces of this ring are finished and have end plates carrying bearings bolted to them. The back plate has four holes for ventilation, and the front plate has two hinged doors to admit of free access to the brushes. By this construction, the end plates can be turned either

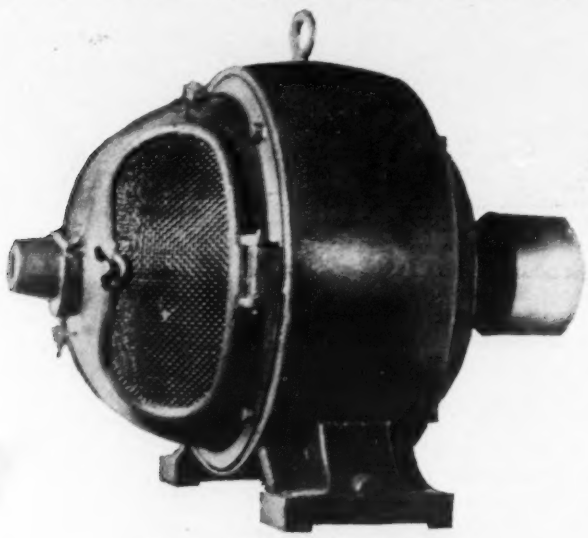


FIG. 2.—DYNAMO AND MOTOR.

90 or 180 degs., so that the motor can be adjusted for floor, wall or ceiling suspension. Fig. 1 shows a slightly different type used for 1 horse-power only; Fig. 2 shows type used for from 2 to 10 horse-power. The armatures of the slotted drum type are of large diameter, and mica is used throughout for insulation.

The commutators, which are of ample size, are made from best copper insulated with sheet mica throughout. The bearings are phosphor bronze and self-oiling, and special grooves in the end plate are provided to prevent slinging of the oil. The field coils are wound on removable fiber bobbins, and are carefully taped with heavy linen tape. They are held in place on the magnet cores by removable pole shoes. The brush holders are of the well known reaction type.

Direct Current Motors of the Lundell Type.

The design of the Lundell type of motor makes it particularly adapted to special applications, of which we illustrate an example, showing a Lundell motor geared to a Saunders' pipe cutting and threading machine. Fig. 1. This equipment consists of the Lundell standard round type, compound-wound motor operating at standard rated speeds. It is entirely enclosed, having suitable trap doors at commutator end to enable access to brushes and commutator. Upon the motor shaft is mounted a suitable steel pinion, which meshes in a cast-iron cut-gear wheel located upon the main driving shaft of the machine.

The motor is substantially mounted upon a cast-iron bracket, which is rigidly fastened to the frame of the pipe-cutting machine. Beneath this bracket is fastened the necessary resistances which are used in connection with the controller for operating the motor at its various speeds. For controlling the motor there is used the Sprague Company's standard rotary controller, which permits the motor to be operated at eight different speeds in both forward and reverse direction. The reversing of the motor is accomplished by an extra reversing cylinder which is mounted alongside of the main cylinder in the controller. This controller is so arranged as to enable a speed regulation of motor between normal and maximum of 20 per cent by inserting resistance in series with the shunt field winding of motor, and 50 per cent reduction in speed obtained by means of armature regulating resistance inserted in series with the armature. The arma-

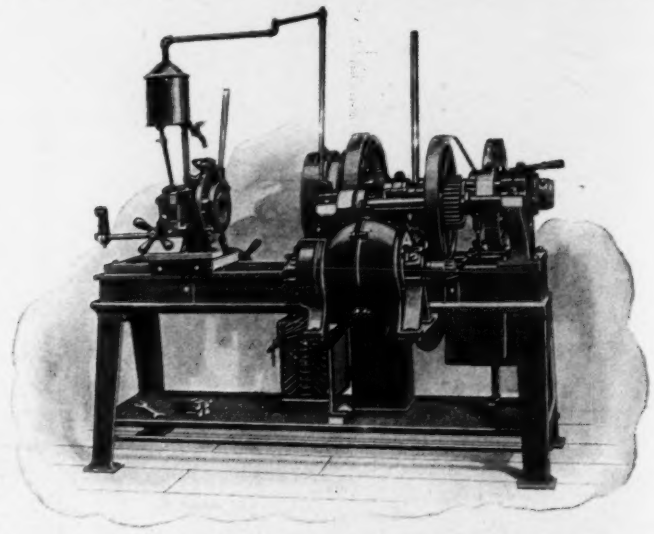


FIG. 1.—ELECTRICALLY-DRIVEN PIPE CUTTING AND THREADING MACHINE.

ture and shunt field resistance is self-contained, and is so constructed that it is practically indestructible, the resistance wires being entirely enclosed in special iron box castings, making them both oil and fireproof.

For protecting the motor from severe overloads, there is used a standard circuit breaker which is connected in the main line circuit, and which will automatically interrupt the circuit if a severe overload is put on the motor. There is also used in addition to this a separate knife blade fused switch which is enclosed in an asbestos lined wooden box and fastened to the frame of the machine. This switch is used for controlling the main line circuit to the rotary controller. The above appliances make a very satisfactory operating equipment and are so arranged as to operate at their highest efficiency when the motor is at its normal capacity.

Another interesting application of an electric motor is shown in Fig. 2. A 1-hp Lundell motor, mounted on a universal bracket and equipped with a flexible shaft, has been successfully used in the

Presbyterian Hospital, New York, for working the surgical instruments in such operations as trepanning the skull, drilling and sawing bones, etc. By using the motor operations have been performed in a much shorter time and with less pain to the patient than is possible

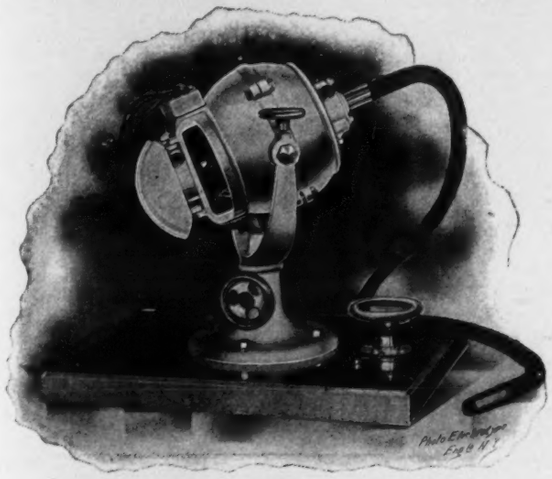


FIG. 2.—MOTOR WITH FLEXIBLE SHAFT.

by the old method of chopping with chisels and using ordinary hand saws. The general arrangement of supporting the motor and the method of attaching the shaft enables the motor to be operated at a very high speed with maximum power, and with no vibration when guiding the instrument with the hand.

The New Eck Motor.

Mr. C. A. Eck, the proprietor of the Eck Dynamo & Motor Works, of Belleville, N. J., has just designed and brought out a new type of motor, which embodies a number of features of interest and is herewith illustrated. The field consists of a circular yoke of such section as to secure the most efficient working and best regulation without being unduly heavy. The cores are round, thereby involving a minimum of copper in the field, and are made of soft wrought iron set

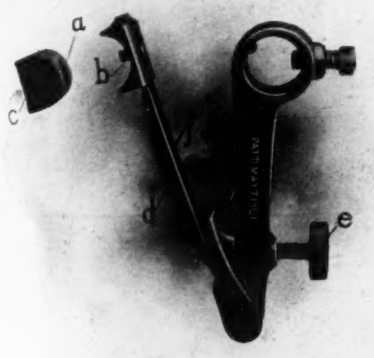


FIG. 1.—BRUSH HOLDER.

FIG. 2.—MOTOR.

deeply in the magnet frame to insure a perfect joint and a large contact surface. The pole shoes are carefully shaped so as to produce a uniformly distributed field in the air-gap, which, with careful proportioning of the winding, secures sparkless operation under all changes of load without shifting the brushes.

The armature core is of the slotted or toothed type, built up of thin annealed sheet steel. The winding is first baked to remove all moisture, then dipped in best insulating varnish and again baked. The commutator is large and of great radial depth. Special provisions are made for additional fastening of the armature winding beside soldering it to the commutator segments. The patented brush holder, is shown herewith. The brush, which has a convex curve, *a*, that fits a concave curve, *b*, in the holder, is allowed to turn slightly and to adjust itself to the periphery of the commutator at point, *c*; and the semi-circle having its center near the periphery of the commutator, the tendency of the brush to turn and to wear on one side only is eliminated. A flat tempered steel spring, *f*, presses the brush holder against the brush, the tension being adjusted by a screw, *e*, made so as to prevent it from turning through vibration. Two or more copper strips, *d*, running alongside the steel spring carry the current. After being used on the Eck motors continuously for over one year the brushes have demonstrated that they give perfect contact between brush and commutator, and brush and holder, with a total absence of any disagreeable chattering or squeaking noise, while their easy self-adjustment to the commutator reduces the wear on the brush and commutator to a minimum, giving the latter the much desired polished mahogany appearance.

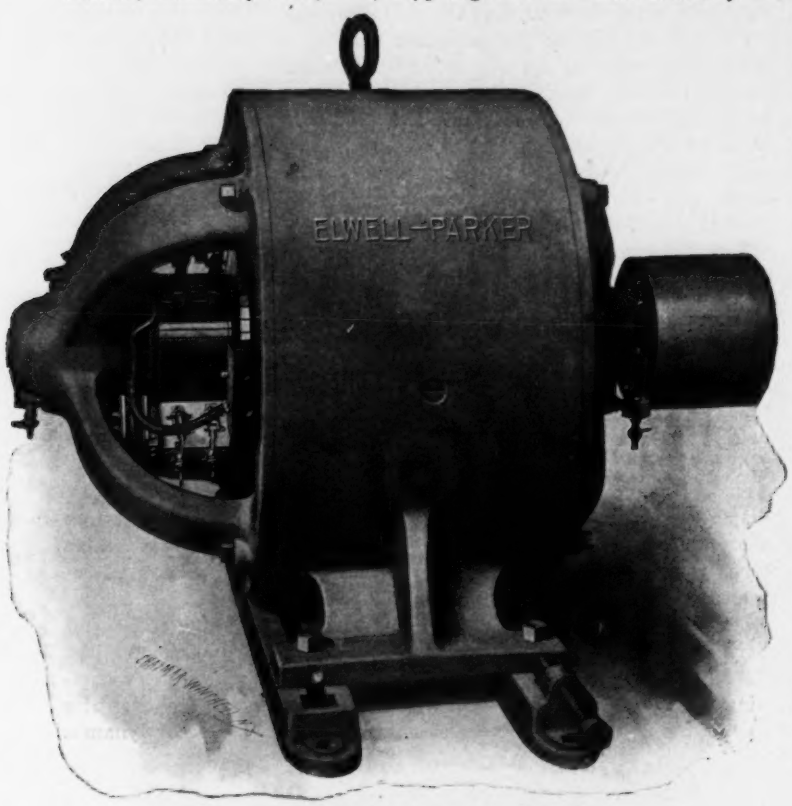
The Eck semi-enclosed and enclosed type dynamos and motors are provided with patented swiveling shields which expose the interior of the machines to view and permit easy access to the brush holders and brushes by simply turning the shield one-quarter of a turn in the fashion of an ordinary stove damper until it stops, and vice versa. Mr. Eck finds this to be more economical than shields fastened with small screws, the unfastening of which always means more or less time lost, and it is more convenient than hinge doors which require almost as much space as the machine itself when opened. Tension springs, producing the proper friction, keep the shields tight, dispense with locking and prevent noise that might be caused through vibration. Another fact not to be overlooked, is that no matter whether opened or closed, the machines always present the same symmetrical and complete appearance.

As some insurance companies insist upon tin pans being placed under the machines in order to prevent the oil from running upon the floor, the concern has designed and furnish with its machines a combination sliding base and oil pan. This not only saves the cost of a pan, but also adds to the safety from fire, as many users of dynamos and motors make a practice of screwing the machine and pan to the floor with lag screws, perforating the pan, and thus permitting the oil to leak through the openings around the screws.

The Eck Works make three different styles of machines, viz., the protected type, without swiveling shields, with a strong cast iron bracket joined to the frame; the semi-enclosed type, with apertures in the swiveling shield, permitting ventilation; and the enclosed type with swiveling shields made solid, recommended for machinery put in inaccessible places, where they can receive little or no attention, or where they are exposed to dust, dampness, flying chips, etc.

Round Pattern Motors.

The round pattern power motor herewith illustrated in being built by the Elwell-Parker Electric Company, of Cleveland, Ohio, on low and moderate speed ratings, in sizes from 1 horse-power up to and including 40 horse-power. In the type shown, Mr. F. C. Phillips informs us, they are able to get from a machine weighing 925 lbs. an output of 12½ horse-power without sparking or heating beyond the normal, customary limit, i. e., a 75 deg. F. rise. The efficiency of



ROUND PATTERN POWER MOTOR.

this motor, when giving the above output at from 1150 to 1175 r. p. m. would not be less than 82 per cent. The bearings of the motor are made in one piece of special bronze, and are seated in the motor heads so as to be self-aligning; and can be taken out for repair or replacement in a few minutes. There is a spacious oil chamber with two oil rings for each bearing. A special feature is the simple but efficient brush gear, in which the brushes can be quickly replaced, and on which the tension can be adjusted to a nicety. This motor represents the latest type of the company's round pattern product.

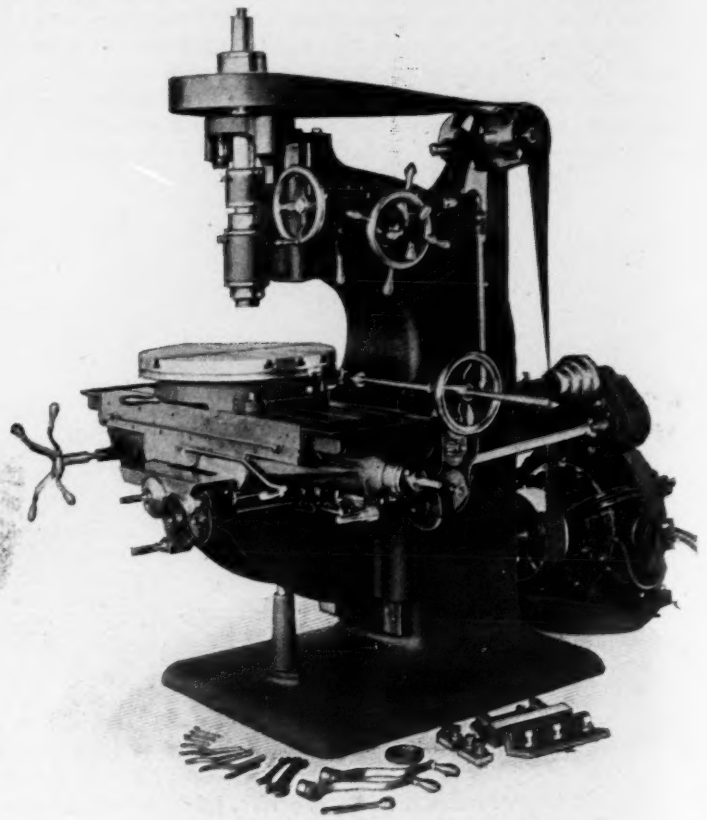
A Motor Driven Miller.

An interesting exemplification of modern American ingenuity in machine tools, and the driving of such tools by motors, is afforded in the Becker miller illustrated herewith, made by the Becker-Brainard Milling Machine Company, Hyde Park, Mass. This tool performs a very wide range of work, and is of the most convenient size for the majority of machine shops and factories. This particular tool has lately been on view at the Pan-American, where it has attracted considerable attention. The spindle has long bronze bearings made adjustable for wear. The mills are secured rigidly by means of a draw-bar. Large surface mills are fitted to the threaded nose of the spindle. The spindle driving pulley, mounted upon an adjustable auxiliary bearing (Becker's patent), is back geared 5 to 1; the spindle pulley is 16 inches diameter, 4 inches face. To balance the action, back gears are made in duplicate. The head has automatic or hand movement of 9 inches, and an automatic stop-dog which will throw out the feed at any point within the limit of its vertical movement, thus making this tool an excellent vertical-boring machine. A micrometer stop-gauge located at the upper left-hand side of the frame accurately gauges the depth of any cut. The platen is 51½ inches in length over all and 14 inches wide, with 42 inches automatic feed in either direction. It has quick return motion, geared 3 to 1; oil channels conduct the oil to removable oil pockets. The saddle is the same length as the platen, with automatic feed in and out of 16 inches. Both feed screws are dialed. The knee has automatic vertical feed; the extreme distance between spindle and platen is 21½ inches; between spindle and rotary table, 16 inches.

The rotary attachment has graduated table, 22 inches diameter. It is fed automatically in either direction. Adjustable dogs are attached to the periphery of the table to automatically trip the feed. The table feeds are derived from compounded gears giving eight changes for each change of spindle speed. The intermediate gears on rotary feed bracket are interchangeable, increasing the speed 6 to 1, thus providing 16 changes of feeds for the rotary attachment. The arbor support is attachable to the knee, and is used only when side milling with long and slim cutters necessitates such support. The vise jaws are 9 inches long, 2½ inches deep, working in connection with the T slots of the table.

The Sturtevant motors used with this tool are designed specially for direct connection to this type of milling machine. The variation of speed required for different sizes of cutters where working different metals is very great and on the type of machine referred to with its usual back gearing the range of speed required of the motor is from about 250 r. p. m. to 750 r. p. m. The usual method of reducing the motor speed by means of a rheostat in armature circuit cannot be used on this class of work, as the speed, being dependent upon the load, varies with the depth and width of every cut and increases when the cutter is running out, thereby burning the cutter teeth and ruining it. On this account rheostatic control as usually considered is not attempted at all, the various speeds being obtained by means of a special armature having two commutators, the two separate windings of which are used either independently or together in conjunction with a variable field. All of these changes are made by a simple controller of the enamel type which is placed upon the side of the machine.

The motor is of the eight-pole type, with tripod bearing hangers, and is either open or enclosed as specified. An enclosed motor is perferable on the score of safety from flying chips, etc. The frame of the motor is a steel casting having the tripod hangers bolted to it. The armature is of the toothed drum type, having a commutator on each side. Carbon brushes are invariably used. The method of speed variation employed is such that the motor can be used in any shop having either 110, 220 or 500-volt power service, and does not require any special complex generating plant or wiring system to make it operate satisfactorily.



MOTOR-DRIVEN MILLING MACHINE.

Crocker-Wheeler Engine Type Generator.

The accompanying illustration shows a Crocker-Wheeler railway generator direct connected to a vertical engine. In designing this machine the Crocker-Wheeler Company was mindful of the exacting requirements of railway work, and particular care was bestowed in its production to combine in it all the time-tried elements of dynamo electric machinery that have proven to be of value. Among the special features of design and construction, as set forth by the company, may be mentioned low-current density in windings, commutator, brushes and other conducting parts; adequate means of ventilation; a substantially flat efficiency curve and a nearly straight compounding curve. The magnet frame is a cast iron ring of girder construction, divided horizontally, the two halves being fastened together by bolts and kept in accurate alignment by dowels let into the frame. The

ENGINE TYPE GENERATOR.

round steel poles are cast-welded into the frame in such a manner as to insure a perfect magnetic joint. Each pole is fitted with a removable shoe, designed to produce the best distribution of the magnetic flux where it enters the armature, and to give a comparatively large air-gap between the armature and field. The armature is of the iron-clad type, the core being formed of toothed laminations made of mild steel. The field coils are easily removable from the poles. The machine throughout has been given the closest attention as to details and quality of material and finish, and in every way represents the high standard of this company's work.

Band Polishing Machine.

We illustrate herewith a new "sit down" band polishing machine just being put on the market by Charles H. Besly & Co., Chicago, Ill. This form of stand is very desirable, as it permits the operator to be seated while at work. The Besly band wheels used on this machine are made of semi-steel castings, and when an elastic surface is required they are covered with felt. The emery or other abrasive material is applied to the wheel on a cloth band, which may be tightened firmly around the wheel. To reset the wheel, or change the grade of emery, it is necessary only to remove the band, and replace it with another—an operation requiring only one or two minutes of time.

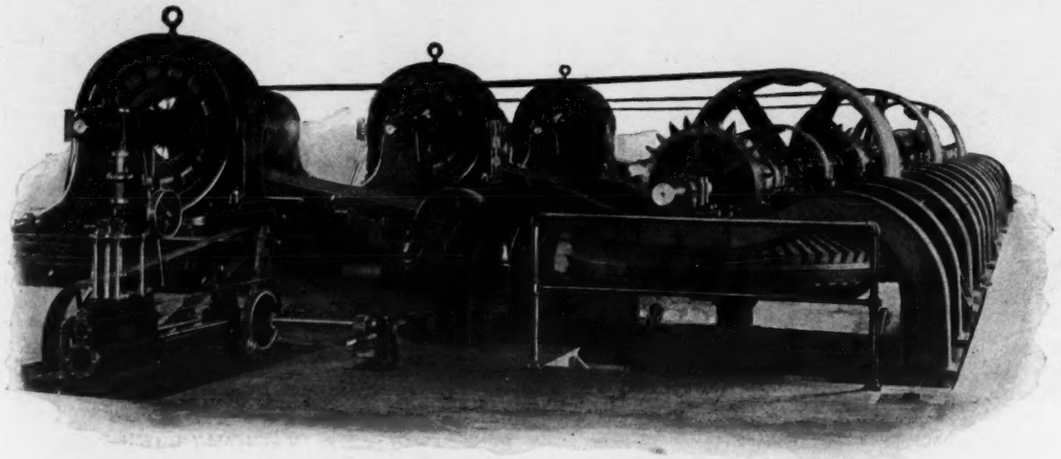
One of these wheels will take the place, and do the work, of a large number of polishing wheels. The wheels when used with emery bands are always balanced and ready for use. This machine is suitable for shops where skilled polishers are not employed, as well as in those employing skilled labor. An ordinary shop boy with a little practice can do the work of a skilled polisher.

BAND POLISHER.

These grinders are made so that a single Besly band wheel can be used; or with double spindle, two band wheels may be used, or a band wheel at one end, and a regular buff or emery wheel at the other end of the spindle. Besly wheels are made with cushioned or with hard finish.

Water Power Plant at Silver City, Idaho.

The Trade Dollar Mining Company, of Silver City, Idaho, has lately installed a hydro-electric plant to operate its machinery by electric power at that place. The plant is illustrated herewith. It comprises three belt-driven Westinghouse generators operated by four vertical shaft 72-inch McCormick turbines, developing 3600 horse-power under 19-ft. head, the turbines being furnished by the S. Morgan Smith Company, of York, Pa. The gates of the four water-wheels are operated by means of one Lombard governor working in connection with a lever gate hoisting device, which makes it possible to dispense with all such gears as are used in ordinary practice.



SILVER CITY MINE POWER PLANT.

A New Consumer of Niagara Power.

A new consumer of Niagara power, on the land of the Niagara Development Company, at Niagara Falls, N. Y., is the McPherson Switch & Frog Company, W. B. Rankine, manager and director, whose new plant on Iroquois Street is rapidly nearing completion. This company will use intermittently 130 horse-power of current, in operating motors ranging from 5 to 75 horse-power capacity for individual machines and Ingersoll air compressors. Its specialty is the McPherson safety switch and frog—a patent which has been before the public for nine years. It is not yet in as general use as it deserves, but doubtless will be soon. The switch consists of a device which lies inert along the main track, making no break whatever in the line, until a train goes into the siding. Ninety per cent of the trains in daily operation use only the main track, yet the switches and frogs in common use receive the wear and tear of every train, necessitating frequent renewal and constant supervision, as well as a slowing down of trains when the switch is approached. With the McPherson switch, there being absolutely no wear and tear upon it, excepting by the 10 per cent of trains, which use the siding, 90 per cent of saving is effected by their use. There is also a saving in fuel since no slowing down of trains is required, and a better speed is thus attained.

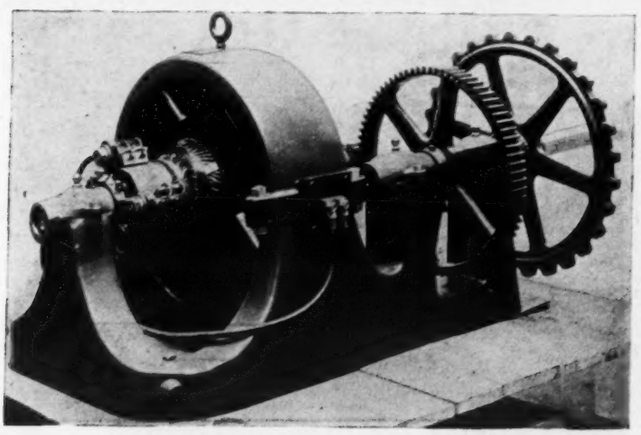
On a short line of the Canadian Pacific Railroad, the McPherson switch and frog are in use on a track having 90 miles of continuous main line without a break, though sidings occur at average intervals of six miles during the entire length of the road.

This company has another plant in process of erection on the Canadian side of the river, to meet the demands of the Canada trade. The plant at Niagara Falls, N. Y., will be completed and in full operation within five weeks, and ready to fill orders, of which it has a large number already on hand.

New Back-Geared Motor.

Slow-speed machinery requiring minimum driving speed at moderate cost has found a desideratum in the back-geared motor, through which it is possible by means of perfect alignment, rigidity, well-oiled bearings and smooth running gears to reduce the extra friction to a minimum. The illustration shows a type of such a motor intended for general work, made by the E. G. Bernard Company, of Troy, N. Y., and installed at the Dobler Brewing Company, Albany, N. Y. Fitted with sprocket wheel, as shown, it is used to operate a keg elevator, to which it is attached by means of an endless chain.

This motor is 10 horse-power, 675 r. p. m., back-geared to 135 r. p. m. The entire base and pedestals are cast in one piece and are exceedingly rigid. The bearings are in perfect alignment. The gear



BACK-GEARED MOTOR.

bearings are the same as the motor bearings, and are those regularly used by the Bernard Company, made of one solid piece of chemical bronze, with self oiling rings. All shafting is made of hammer-welded steel at a pressure of 75,000 lbs. per square inch. The gears are Brown & Sharp machined. The spurs are of cast iron, the pinion of leather, having brass flanges, insuring ample strength and absence of noise in operation. All possible speeds are obtained by using the proper ratio of gears.

Aaron Multipolar Dynamo and Motor.

In the type of machine illustrated herewith, manufactured by the Aaron Electric Company, 141 South Clinton Street, Chicago, all connections are made on the outside of the machine, which is an evident advantage. The motors are designed for either wall or ceiling suspension, and their construction is stated to embody the latest

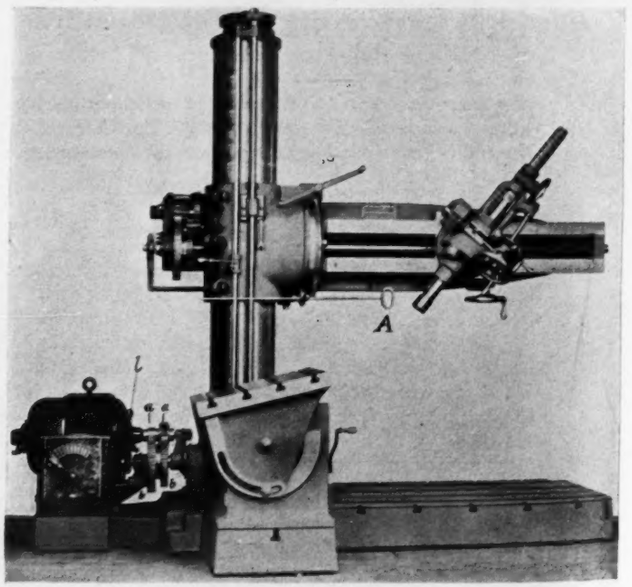
MULTIPOLAR DYNAMO AND MOTOR.

and best engineering practice. The commutators are made exceptionally large, insuring long, cool running of the machines. The new and improved brush holder also aids in keeping down the heat. Dynamos of this type are made in 10 sizes, ranging in capacity from ¾ to 7½ kilowatts, and motors in the same number of sizes, ranging from 1 to 10 horse-power, the machines being wound for all standard voltages.

Motor-Driven Radial Drill.

A compact form of radial drill is shown in the cut herewith of the 6-inch full universal radial drill, motor driven, of Dreses Mueller & Co., Cincinnati, Ohio, which they have lately introduced.

The speed variation obtained in a four to five step cone of the ordinary machine tool is about in the proportion from 4 to 5:1. Motors



ELECTRICALLY DRIVEN DRILL.

of this difference in speed are not only high in price, but undesirable. To overcome this objectionable feature to a great extent the firm uses a motor with a speed variation of only 2:1, and makes up the difference in the attaching gearing. The pinions *a a* are of rawhide, and are fast on the armature shaft. They mesh with the large gears *b b* running loose on the shaft carrying otherwise the cone pulley. By means of a friction clutch, operated by lever *l*, these gears are alternately clutched to their shaft, and so, by their proper proportion, make

up the difference. In use, the gearing is covered by a bonnet to keep the dust out and avoid accidents.

For convenience of the operator, the driving gearing of this machine is so arranged that by means of the adjustable rod *A* the drill can be started, stopped, the back gears engaged and the spindle reversed quickly without going to the rheostat or speed controller.

The McKenzie Traveling Grate Stoker.

Among several types of automatic stokers which in the past few years have been placed upon the market, is one originated and patented by Mr. Dougal J. McKenzie, of Chicago, Ill., which is illustrated herewith. One great advantage claimed for this stoker relates to the disposal of clinkers, which, in the case of the McKenzie stoker, are disposed of automatically without any annoyance and expense by having this refuse travel back and over what is known as a clinker apron, which fits snugly to the rear end of the traveling grate, and which in turn is kept cool by means of a cold water circulation. Proper ventilation is provided for by having the whole stoker tightly bricked in and the ash receiver at the rear end, in which the ashes

TRAVELING GRATE STOKER.

and clinkers are dumped, kept closed automatically except when refuse is occasionally dumped, which is once every four or five hours. An improved brick coking arch, with adjustable tiles at the front end of the furnace, facilitates the coking of fresh coal as it enters from the coal hopper. Another marked advantage claimed for the McKenzie stoker is the fact that a fire can be easily started or banked as in the old style of hand-fired furnace.

The stoker, with which any type of boiler can be equipped, is built upon the principle that coal fired automatically can be so correctly and perfectly suspended in the atmosphere as to admit the necessary amount of oxygen to every square inch of coal over the entire grate surface, and thus produce perfect combustion. In carrying out this principle a grate bar of great strength has been constructed with only 50 per cent of metal to the square foot on the surface. The thickness of the fire bed is automatically controlled according to the power required and the amount of coal to be consumed, and at the same time there is no excess of air.

This machine is not what is called a "chain grate stoker," consisting simply of a series of small pieces connected together with rods, and forms a belt or chain upon which coal is burned. In the case of the McKenzie stoker, the chains are not subjected to the abuse of the fire, and when anything happens to them, they can be repaired leisurely and without serious interruption of the plant. It is claimed that with this type of stoker a saving in fuel of from 15 to 25 per cent over the ordinary method of firing can be made. The McKenzie stoker is manufactured by the McKenzie Furnace Company, Chicago.

Electrical Drive for a Stereotype Plate-Shaving Machine.

We show herewith an illustration of a Hoe plate-shaving machine equipped by the Jenney Electrical Manufacturing Company, of Indianapolis, Ind., with a Jenney universal type motor and a special starting and stopping switch designed for the machine.

The motor is compound wound, and is rigidly mounted on the end of the machine by special castings. The power is delivered through a rawhide pinion engaging a cut gear mounted on the worm shaft of the shaving machine. This gear and pinion is fully protected by a cast-iron guard. The starting and stopping switch is mounted on slate just above the motor in convenient reach of the operator. The stud supporting the lever of this switch is attached to the end of the shaft that carries the shaving knife.

After the plate has been placed in position ready for shaving, the operator pulls the lever towards him against the limit stop, when the motor starts gradually, and the motion of the shaving knife cuts the resistance out of the armature circuit; so that when the knife commences to shave the plate, the motor is running at full speed, and

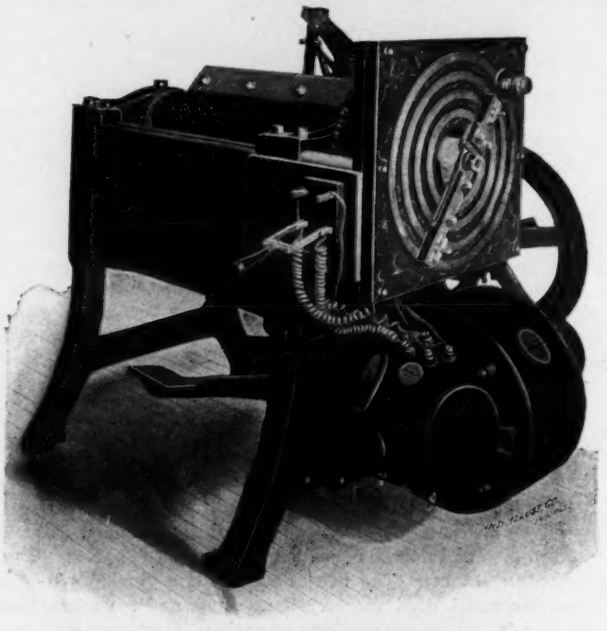


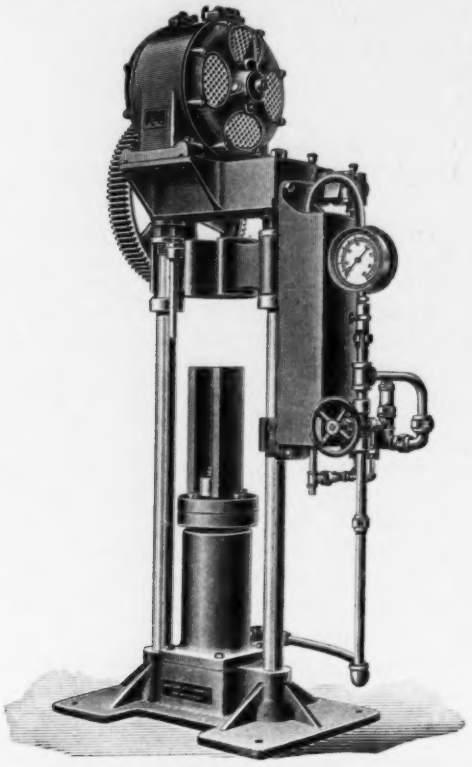
PLATE-SHAVING MACHINE.

continues to do so until the plate has been shaved. The momentum of the machine then carries the switch lever around to a point where connections are made that convert the motor into a generator through a light resistance load, which load is gradually increased until the motor is brought to a standstill at exactly the proper position for the operator to remove the shaved plate.

This equipment, and those provided by this company for other stereotyping machinery, not only result in a substantial saving of time for the operator, but accomplish a very material reduction in cost of operation, economize floor space, and, being self-contained, allow the machine to be located in the most convenient position and to be easily moved when desired.

Thirty-Ton Motor Driven Armature Press.

The small press shown in the accompanying cut is patterned after a larger 60-ton tool shown, but modified at the top to secure a good foundation for a motor. The upper beam revolves upon ball bearings to permit of its being easily pushed out of the way to allow of armature being built up or more disks being put on the shaft without removing it from the press. The motor shown is one manufactured by the Westinghouse Electric & Manufacturing Company. It has a



30-TON MOTOR-DRIVEN ARMATURE PRESS.

4-inch rawhide pinion on the armature shaft meshing with a cut gear 24 inches by 3 inches in diameter. This is upon the pump shaft. The pump has a piston ¾ inch in diameter, and is double acting. The press ram has a motion of 9 inches. The distance between rods is 15½ inches. The removable "U" block is 18 inches high and its top 9 inches from the lower side of the swinging beam. The jaw of the beam and the block are large enough to permit of the pressing of work on a 3-inch shaft. The press complete as shown weighs 2200 lbs., including the motor. The press is made by Watson-Stillman Company, 204 East Forty-third Street, New York City.

Ferracute Machine Company's Pan-American Exhibit.

The Ferracute Company's Pan-American exhibit consists of 12 presses for various kinds of sheet metals, also a number of attachments and dies, and a large collection of samples of sheet metal work and photographs, etc. The machinery exhibited includes two foot presses, one small, used for very light work, and the other, larger, especially adapted for can making and various other sheet metal work up to 6 inches diameter. There are a number of special features in these presses in the way of treadle stop, rubber pumpers, special adjustments and clamping arrangements, etc.

Among the power presses is shown one with dial feed attachment. The legs are arranged so that the center of oscillation is directly under the bed, with an improved screw arrangement for running down or lowering the bed from level to inclined position. The dial-feed attachment is arranged for feeding various kinds of work rapidly into the press, the work being carried around by the dial and holders under the dies and delivered at the left side of the press. This attachment provides an accurate and simple method of feeding.

Two heavier power presses are shown. One is a plain punching press and embodies a number of valuable features in the arrangement of the ram adjustment and eccentric and is fitted up in such a manner that the stroke is changeable. The ram bearings are unusually wide and long, and there are special arrangements for clamping and holding the dies, and a number of other features which are not found in other makes of presses. The larger press is fitted with a double feed roll attachment for feeding strips of metal into the dies in cutting blanks and for various other work. This feeding attachment is very simple and accurate, and can be detached quickly, and the press can be used without it. These two presses are of a series of presses, six sizes of which are without gearing and six sizes with, and they are used for a variety of work in thick metals, for sewing machines, hardware and typewriters, etc., in cutting, shearing and forming.

Another press is a special machine provided with an index feeding attachment which is used for cutting armature disks, the feeding arrangement being changeable for a great variety of notching on any size of work from 3 inches to 48 inches diameter. This style of press is used in electrical factories largely.

A number of the presses are provided with dies showing the operations of making small souvenirs, pans or plates, with an artistic design representing the progress of the country and a Buffalo in the

EXHIBIT OF PRESSES, DIES, ETC.

center. A number of dies are also shown illustrating the various processes in the manufacture of sheet metals.

The general design of the machines and the neatness of the whole exhibit has attracted considerable attention, and a gold medal has just been awarded the Ferracute Machine Company, Bridgeton, N. J., for its exhibit. It may be added that all the operative machinery in this fine exhibit is driven by electric power, whose use it illustrates admirably.

Belting at the Pan-American.

Charles A. Schieren & Co. have been awarded a gold medal at the Pan-American Exposition for their oak bark tanned leather belting and belt leather. The exhibit is in the machinery section, and it consists of an Oriental kiosk, made from the same material that the Exposition buildings were made, one of the artistic features of the decoration being the wainscoating reaching from floor to ceiling on all sides, and made from samples of leather belting, showing the various grades of leather and fastening at laps of belting used by the house. The exhibit proper consists of a 72-inch, 3-ply leather belt, 165 ft. in length, made for the People's Tramway Company, of Putnam, Conn., which is undoubtedly the largest 72-inch belt ever made in this country. In addition to this large belt they have exhibited rolls of smaller sizes, showing the different grades manufactured, and in the electric power plant of the Exposition they have had a 20-inch double and seven or eight 12-inch double leather belts running ever since the Exposition began. These belts are treated with "Leatherine," a composition which renders the belts impervious to dampness and water, and gives the belt more dynamic power than a belt which is not so treated.

A practical demonstration of the value of "Leatherine" occurred during the heavy storm recently, when the roof of the Exposition power house leaked and wet all of the belts in operation. The only belts that held together at the laps, it is said, and were not rendered useless were the Schieren ones filled or dressed with "Leatherine."

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Money on call closed nominally at 3 per cent. Time money, which was easy throughout the week, closed at 4¼@4½ per cent for high grade loans, and 4¾@5 on mixed collateral. The stock market exhibited a tone of firmness and advances were recorded. A feature was the investment buying of high-grade dividend stocks, in some of which new prices were recorded. In the industrial list, United States Steel Corporation securities were very dull, and sold off a little. The favorable accounts of the condition of the steel trade tended to check any disposition to sell steel stocks. Metropolitan Street Railway and Brooklyn Rapid Transit were both heavy, the former closing at a figure 2⅛ points below that at the close of the previous week, and the latter ⅛ point below. Comparatively little business was done in Metropolitan, the sales aggregating 8600 shares. The sales of Brooklyn Rapid Transit were 29,860 shares, the quotations ranging between 60¼ and 62½, closing at 60¾. General Electric was firm on narrow trading, the sales amounting to only 1400 shares. The price ranged between 256 and 259½, closing at 258, a net advance of 1 point. Western Union lost ⅜ point on sales of 2300 shares, the closing figure being 91½. American Telephone & Telegraph lost 1 point, closing at 158½. American District Telegraph closed at 37, which is a net gain of 5 points. In the market for outside securities there was no special feature. Copper stocks were quiet, and Electric Lead was steady, with sales of 800 shares on Saturday at 2¾ to 3. Following are the closing quotations of Tuesday, Oct. 29:

NEW YORK.

	Oct. 22.	Oct. 29.		Oct. 22.	Oct. 29.
American Tel. & Cable..	—	—	General Carriage.....	¾	⅞
American Dist. Tel.....	—	37½	Hudson River Tel.....	112	112
Brooklyn Rapid Transit..	61½	62	Illinois Elec. Veh. Trans.	½	—
Commercial Cable.....	—	—	Metropolitan Street Ry..	157¾	156
Electric Boat.....	18	19½	N. E. Elec. Veh. Tran...	—	—
Electric Boat pfd.....	45	40	N. Y. Elec. Veh. Tran....	6¾	7
Electric Lead Reduc'n...	2½	2⅝	N. Y. & N. J. Tel.....	166	166
Electric Vehicle.....	1¼	1½	Tel. & Tel. Co. of Am....	—	—
Electric Vehicle pfd.....	3½	3½	Western Union Tel.....	91½	91¼
General Electric.....	258	256			

BOSTON.

	Oct. 22.	Oct. 29.		Oct. 22.	Oct. 29.
Am. Tel. & Tel.....	158¾	158	Mexican Telephone.....	2	2
Cumberland Telephone...	—	—	New England Telephone.	—	—
Boston Electric Light....	—	—	Westinghouse Elec.....	—	72*
Erie Telephone.....	36	—	Westinghouse Elec. pfd.	78	78*
General Electric pfd.....	—	—			

PHILADELPHIA.

	Oct. 22.	Oct. 29.		Oct. 22.	Oct. 29.
American Railways.....	40	39½	Phila. Traction.....	95¾	95½
Electric Storage Battery.	60	65	Philadelphia Electric.....	5⅛	5
Elec. Storage Batt'y pfd..	60	65	Pa. Electric Vehicle.....	½	½
Elec. Co. of America.....	6⅝	6⅜	Pa. Elec. Veh. pfd.....	½	½

CHICAGO.

	Oct. 22.	Oct. 29.		Oct. 22.	Oct. 29.
Central Union Telephone.	—	—	National Carbon pfd.....	84	84
Chicago Edison.....	165	160	Northwest Elev. com.....	39	39
Chicago City Ry.....	201	200	Union Traction.....	17	15¼
Chicago Telep. Co.....	250	235*	Union Traction pfd.....	58½	53
National Carbon.....	19⅛	20⅜			

* Asked.

CENTRAL UNION TELEPHONE.—The financial affairs of the Central Union Telephone Company are now placed in an improved condition. Previous to the recent two meetings of the stockholders the capitalization of the company was: Stock, $6,000,000; bonds, $6,000,000; floating debt, $1,000,000; the stock selling at 40. Under these conditions it was impossible to raise one dollar of money for extensions. Competition had seriously invaded the territory and money was absolutely necessary to save the property. The condition of affairs was fully set forth in President Sabin's circular calling for funds, but the stockholders failed to respond to this appeal. Finally the American Telephone & Telegraph Company said that if the stock was cut in two, each stockholder surrendering one-half, in all $3,000,000 and increased again $3,000,000, this going into the treasury, it would take all of the new $3,000,000 not taken by stockholders at par, notwithstanding the market price for the new stock was but 80. The plan was accepted and carried out. The company now has $2,000,000 new money for development. It operates 80,000 telephone stations in the Middle West. The last sale of the old stock was 42, which is equal to 84 for the new. The $2,000,000 treasury money will provide funds to complete this year's extensions, but the affairs of the company must be financed again in 1902, as fully $2,500,000 of money will be necesary for extensions, unless the parent company again takes stock at 100.

DIVIDENDS.—The directors of the American Light & Traction Company have declared a quarterly dividend of 1½ per cent on the preferred stock, payable Dec. 2. The United Electric Securities Company has declared a semi-annual dividend of $3.50 on the preferred stock. The directors of the Denver City Tramway Company have declared the usual quarterly dividend of 1 per cent, payable Nov. 15. The directors of the American District Telegraph Company have declared a semi-annual dividend of 1½ per cent. Six months ago 1 per cent was declared, and a year ago 1¼ per cent. The dividend is payable Nov. 15. The Westinghouse Electric & Manufacturing Company has declared a quarterly dividend of 1¾ per cent on its assenting stock, payable Nov. 15. The Edison Electric Illuminating Company, of Brockton, has declared a regular semi-annual dividend of 2½ per cent, payable Nov. 1. The Lowell (Mass.) Electric Light Corporation has declared a regular semi-annual dividend of 2½ per cent, payable Nov. 1. The New England Telephone & Telegraph Company has declared a regular quarterly dividend of $1.50, payable Nov. 15, to stockholders of record, Oct. 31. The Pennsylvania Telephone Company has declared a quarterly dividend of 1½ per cent, payable Oct. 28. This places the stock on a 6 per cent dividend basis instead of 5 per cent, as formerly.

AMERICAN LIGHT & TRACTION.—The Southern Light & Traction Company, San Antonio, Tex., controlled by the A. L. & T. Co., is likely to pass the dividend, payable about Nov. 20. The directors must either take this course or else issue bonds. The company has rebuilt its tracks in the last year or two at a cost of over $100,000. When the franchises were renewed in April, 1898, it was stipulated that the company must pave certain streets in which the tracks are laid, and this work has cost about $150,000. A number of new cars have been purchased. The company will consolidate its electric lighting and traction plants at a cost of about $20,000, and will rebuild the distributing system of the traction company at a cost of over $50,000. Large sums of money will thus be required. Southern Light & Traction bonds are selling at 82, and some of the directors think it would be preferable to discontinue dividends rather than to sell bonds at such a price. It is stated that the net earnings of the American Light & Traction Company for the quarter ended Sept. 30, 1901, amount to $119,184, an increase of about 11 per cent, as compared with the corresponding quarter in 1900. After deducting from this sum $99,615 to pay the quarterly dividend of 1½ per cent on $6,641,000 of preferred stock, a surplus remains of $19,569.

HELENA POWER & LIGHT.—Application has been made in the United States Court for the appointment of a receiver for the Helena Power & Light Company. The proceeding is commenced in the interest of the Central Trust Company, which holds bonds of the company. The court signed an order appointing H. L. Walker, secretary of the company, as receiver. The trust company is trustee for the bondholders. For some time the company has defaulted on interest on its bonds. The company owns the gas, electric light and street car plants in Helena. According to last reports, it had issued only $600,000 of bonds. The capital stock is $1,000,000. The company has a 14-mile transmission plant.

A WESTINGHOUSE COPPER RUMOR.—A report current in Wall Street, but not confirmed, as explanatory of the weakness in Amalgamated Copper, is that the Westinghouse Company, which is one of the largest consumers of copper in the country, has just concluded the purchase of a large independent copper mine, which the Westinghouse people purpose to work from this time on, withdrawing their custom from the Amalgamated. The report is denied, while similar rumors are current as to the General Electric Company.

ERIE TELEPHONE.—Dudley E. Waters, president of the Grand Rapids National Bank, is at the head of a syndicate of Michigan capitalists, who have secured a 30-day option from the executive committee of the Erie Telephone & Telegraph Company to purchase from that company all its holdings in the Michigan Telephone Company, 30,000 shares, a controlling interest.

Commercial Intelligence.

THE WEEK IN TRADE.—The volume of business during the past week was so great that the railways complained of car shortage, this condition existing in all parts of the country, and reports from the principal centers state that transportation facilities for the business offered the several lines are inadequate. This is particularly true in the case of iron ore and steel, lumber, grain and coal. Wholesale and jobbing trade generally is characterized as fair to moderate the country over. Collections are generally good, except at the South,

where slower movement of cotton has tended to retard business. As for some weeks past, the iron and steel trade returns the best reports. The largest steel rail order of the year was placed during the week, aggregating 160,000 tons, being taken at the ruling rate of $28 per ton by the Pennsylvania Railroad Company, and some other large orders from other companies are now under negotiation. In all, 1,500,000 tons for 1902 delivery have been booked. Special activity is noted in structural material at Pittsburg. The market for wire products is lagging, but special activity is noted in hardware at all markets. The gross railway earnings of all roads so far as reported for October, aggregate $27,486,795, a gain of 8.3 per cent over last year. The business failures during the week, as reported by *Bradstreet's*, aggregated 223, as against 198 the week previous, and 161 the same week last year. In copper, the situation is practically unchanged, notwithstanding the press reports regarding large sales and increased activity. The reported sale of 30,000,000 lbs. of Lake copper for home consumption is generally discredited. None of the large consumers are buying into the future, present prices being considered too unsafe. Quotations are 16.85 to 17 cents for spot Lake; 16.30 to 16⅝ for electrolytic; 15⅝ and 16.30 for casting stock.

EXPORTS OF ELECTRICAL MATERIAL AND MACHINERY.—The following are the exports of electrical material, machinery, etc., from the port of New York for the week ended Oct. 23: Antwerp—Material, 17 packages, $952; electrical machinery, 1 case, $45. Argentine Republic—Electrical machinery, 42 packages, $2,607. British West Indies—Electrical machinery, 3 packages, $351; copper wire, 10 bundles, $674. Brussels—Electrical machinery, 2 cases, $300; material, 1 case, $40. Bilbao—Machinery, 1 case, $200. Brazil—Material, 27 packages, $2,476. Bremen—Material, 3 cases, $76. British Australia—Material, 7 packages, $77; machinery, 149 packages, $33,053. British Guiana—Material, 93 packages, $2,923. Copenhagen—Material, 6 packages, $153. China—Material, 16 packages, $461. Chili—Material, 13 packages, $263. Central America—Material, 22 packages, $262; copper wire, 8 bundles, $99. Cuba—Electrical machinery, 8 packages, $300; material, 125 packages, $4,112. Dutch East Indies—Electrical material, 1 package, $14. Ecuador—Material, 3 packages, $70. Florence—Material, 5 packages, $442. Gottenburg—Material, 7 packages, $150. Glasgow—Material, 9 packages, $410; machinery, 3 packages, $720. Havre—Electrical machinery, 48 cases, $5,975; electrical material, 47 packages, $5,431. Hamburg—Material, 19 packages, $745. Japan—Material, 15 packages, $716; electrical machinery, 18 packages, $3,800. Liverpool—Machinery, 191 packages, $17,385; electrical material, 33 packages, $1,454. London—Electrical machinery, 119 packages, $2,902; electrical material, 197 packages, $6,281. Liege—Material, 1 package, $45. Newcastle—Electrical machinery, 27 cases, $7,000. Peru—Electrical material, 22 packages, $348. Riga—Material, 1 case, $50. Rome—Material, 4 cases, $483. St. Petersburg—Material, 13 cases, $405. U. S. Colombia—Material, 6 cases, $509. Venezuela—Material, 1 case, $41. Vienna—Electrical machinery, 33 packages, $3,950. Wiborg—Electrical material, 1 package, $14.

AUTOMOBILES WANTED FOR CRYSTAL PALACE, LONDON.—Mr. Ernest Schenk, president of the London Crystal Palace Company, who, as noted in our columns, has been in the United States for the last few weeks in connection with the American exhibition, to be held at the Palace from May to September, 1902, sailed last week for home. On the eve of his departure Mr. Schenk said to a representative of ELECTRICAL WORLD AND ENGINEER: "I have every reason to be well satisfied with the result of my visit. My chief object in coming here was to lay the matter before the United States Government, with a view to obtaining its co-operation by way of government exhibits. My suggestions were very cordially received by the members of the Cabinet with whom I had interviews in Washington, these gentlemen being evidently alive to the commercial value to the manufacturers of this country of an exclusively American exhibition on an extensive scale during the coronation year. A number of the largest representative firms have applied for space, and it is evident that there will be no difficulty in filling the entire available area of 100,000 square feet." In conclusion, Mr. Schenk said that it was proposed to have a cable tramway constructed from the Low Level station to the exhibition grounds. The distance is about 300 yards, and the gradient is some 8 per cent. It has been further determined to run a service of automobiles, each vehicle having a capacity for 10 passengers—around the beautiful grounds, which are about 200 acres in extent. The route would be nearly 1½ miles in length. Mr. Schenk would be glad to enter into any negotiations with any American manufacturers of electric vehicles who would be interested in the matter.

REVISION OF BANKRUPTCY LAW.—A meeting of the special committee of the Merchants' Association on Revision of the Bankruptcy Act was held at the rooms of the association last week, at which the following members of the committee were present: George F. Vietor, of Frederick Vietor & Achelis, chairman; Ora Howard, of Oelbermann, Dommerich & Co.; Ewald Fleitmann, of Fleitmann & Co.; C. N. Bliss, Jr., of Bliss, Fabyan & Co.; Charles E. Meek, of the National Lead Company; Carl Schefer, of Schefer, Schramm & Vogel; C. H. Webb, of J. H. Dunham & Co.; W. S. Mersereau, of Schieffelin & Co.; R. B. Hirsch, of William Openhym & Sons; Benno Neuberger, of E. Rosenwald & Bro.; Geo. E. Armstrong, of the H. B. Claflin Company; E. W. Riker, of Yale & Towne Manufacturing Company. A general discussion as to methods of operation in analyzing the present act and in suggesting needed amendments thereto was had. As a result thereof an executive committee of five was appointed, with full power to conduct the necessary investigation, to communicate with and receive suggestions from other trade organizations and individuals, not only in New York but throughout the country, and to incorporate their conclusions in a report to the main committee. The executive commitee of five is made up as follows: Ora Howard, of Oelbermann, Demmerich & Co., chairman; W. T. Evans, of Mills & Gibb; E. D. Page, of Faulkner, Page & Co.; R. B. Hirsch, of William Openhym & Sons; E. W. Riker, of the Yale & Towne Manufacturing Company.

NEW PLANT FOR NEWPORT NEWS, VA.—The George A. Williams Company, 268 Washington Street, Jersey City, N. J., have been awarded the contract by the Consumers' Light, Heat & Ice Company, of Newport News, Va., for the installation of new ice plant, water distilling plant, artesian wells, and an addition to electric lighting plant. The amount of contract is $145,000. The George A. Williams Company has awarded the boiler contract to Heine Safety Boiler Company, of Philadelphia; the engine contract to the Buckeye Engine Company, the contract for Hawley down-draft furnaces to Vick, Whiting & Co., of Baltimore, Md., and the contract for the electrical apparatus consisting of two 200-kw, two-phase alternators, one 25-kw, direct-current dynamo, switchboards, transformers, meters, etc., to the Westinghouse Electric & Manufacturing Company, of New York, N. Y. The ice plant and distilling plant contracts have not yet been given out. Bids for this part of the installation are now being received.

THE GRANT TOOL WORKS opened up its new works at Franklin, Pa., Oct. 1, under most auspicious circumstances. Governor Stone, of Pennsylvania, attended by his staff, participated in the proceedings. The large 250-hp engine was equipped in such a manner that the pressing of a button started it, and with it the entire machinery of the shop was put into motion. The Governor, at the termination of the preliminary exercises, pushed the button, thus giving the new works its "send off." The shop was crowded with a number of Mr. Grant's friends, who attended to wish him and the new company good luck. A collation for 3000 people was prepared and served, even that lavish provision proving inadequate for the large number who were present. The employes, as a token of their regard for Mr. Grant, furnished his new private office at their own expense.

CONTRACTS AWARDED.—The Mohawk Valley Power Company, Gloversville, N. Y., has awarded the contracts for the equipment of its new power station near Tribes Hill. The Allis-Chalmers Company has been given the contract for three 1500-hp vertical cross-pound engines, together with pumps, etc. The General Electric Company has been awarded the contract for the electrical equipment, including three 1000-kw generators. The Springfield Boiler Company has been awarded the contract for a battery of 10 boilers, aggregating 5500 horse-power. The Broomell, Schmidt & Steacy Company was awarded the contract for the economizers.

PIPING, ETC., FOR SYDNEY, N. S. W., TRAMWAYS.—The Best Manufacturing Company, of Pittsburg, 39-41 Cortlandt Street, has just made shipment of some 260 tons of pipe, valves and fittings to be installed in the central generating station of the Sydney City & Suburban Tramways, Sydney, New South Wales. It will be recalled that the entire contract—valued at some $800,000—for the equipment of the Sydney station was secured by the General Electric Company. The plant has a capacity of developing 6800 horse-power, and will consist of three 1500-kw G. E. generators and the same number of Allis engines of 1500 nominal horse-power each.

NO WESTINGHOUSE FACTORY WEST.—A report has been given considerable circulation in the West to the effect that at the water power of Little Falls, Minn., a factory is to be established by the Westinghouse Electric & Manufacturing Company for the manufacture of heavy pieces of machinery in its Western trade, not less than $500,000 being spent on a big plant for this purpose. We have made inquiry at the New York and Pittsburg headquarters of the company and are authorized by leading officials to state that there is absolutely no warrant for such rumors.

BRITISH WESTINGHOUSE PLANT.—Our Cincinnati correspondent states that Cincinnati concerns got orders for 1500 of the 6000 tons of machinery needed for the British Westinghouse Electric Company's new plant at Manchester, England.

EQUIPMENT FOR LARGE CANADIAN PLANT.—The National Portland Cement Company, Limited, recently organized with American-Canadian capital for the purpose of constructing and operating a Portland cement plant in Toronto, Ontario, is about to place contracts in the United States for the complete equipment of its projected works, which will be operated by electricity. The initial capacity of the plant will be 1000 barrels per day, but the plans have been drawn up so as to make provision for doubling the output. The construction of the original works will mean an expenditure of nearly $250,000. The Americans interested in the enterprise include W. F. Cowham, managing director of the Peninsular Portland Cement Company, of Jackson, Mich., who is president of the National Company. The Canadian parties chiefly concerned in the scheme are A. T. MacLaren, president of the Imperial Cheese Company; P. W. Stanhope, manager of the Toronto offices of the McCormick Harvesting Machine Company, of Chicago, and Gilbert McKechnie, of Durham, Ontario. The company's offices are in the Janes Building, King and Young streets, Toronto. The capital of the concern is $1,500,000.

ALUMINUM *VS.* COPPER.—An article in this issue of ELECTRICAL WORLD AND ENGINEER describes a switchboard whose bus-bars are of aluminum. This is said to be the first instance of the kind. The high prices ruling for copper have naturally caused consumers to look about for a substitute. Street railways have been experimenting quite extensively with aluminum as a substitute for copper in feed wires. The Old Colony Street Railway Company, one of the subcompanies of the Massachusetts Electric Companies, has been substituting aluminum for copper. President P. J. Sullivan says: "We made a thorough investigation of the use of aluminum by street railway companies as a substitute for copper in feed wires, and, as a result, we installed about 10 miles of aluminum feed wire on the South Shore. The aluminum has given complete satisfaction, and our next order for feed wire will undoubtedly be for aluminum. The cost of aluminum is 20 to 25 per cent less than copper, and its value as scrap has the same proportionate value as copper. We found that aluminum was being used quite extensively by street railways throughout the country." We have noted from time to time the use of aluminum for power transmission circuits.

ROLLER-BEARING CONTRACTS.—The Hyatt Roller Bearing Company, of Harrison, N. J., has been awarded contract for roller-bearing hangers for the new mill of the Atlas Tack Company, at Fairhaven, Mass., 625 by 220 ft., consisting of some 500 hangers. This contract was awarded to Lockwood, Greene & Co., of 93 Federal Street, Boston. This company is also making for the Washburn-Crosby Company a number of heavy main jack shaft bearings for one of its new mills at Minneapolis. The Champion Coated Paper Company, of Hamilton, Ohio, the largest book mill in the country, will be equipped throughout with Hyatt roller bearings, on heavy main lines, as well as heating engines. The company is also installing for the American Cigar Company, Jersey City, a new jack shaft drive containing a new electric drive, including a number of heavy bearings of the Hyatt type.

CITY OF MEXICO WATER SUPPLY CONTRACTS.—With further reference to the $7,000,000 project for the furnishing of a 40,000,000-gallon daily spring water supply for the City of Mexico, Mr. Warren H. Loss, of 52 Broadway, the contractor for the construction work, who has just returned from Mexico, stated to a representative of ELECTRICAL WORLD AND ENGINEER that the actual details of the work and particulars as to the exact requirements in the way of electrical machinery, waterwheels, pumping equipments, etc., would not be determined on until after the various engineering experts returned from Mexico early in December. As already mentioned in these columns the General Electric Company, the Stanley Electric Manufacturing Company, the Pelton Waterwheel Company and the Worthington branch of the International Pump Company will secure the principal contracts.

NATIONAL ACME MANUFACTURING COMPANY.—This concern is a consolidation of the Acme Machine Screw Company, of Hartford, Conn., and the National Mfg. Company, of Cleveland. The new officers are: W. D. B. Alexander, president; D. Elliott, vice-president; O. S. Werntz, treasurer; A. W. Henn, secretary; E. C. Henn, general superintendent, with headquarters in Cleveland. The company has recently been incorporated under the laws of Ohio, with a capital of $750,000. A valuable manufacturing site on the Pennsylvania Railroad at Stanton Street has been purchased, and contract has been let for the erection of a modern factory of brick and steel, 300 ft. long by 50 ft. wide, and four stories high, which will be equipped with electrical power.

THE HUBBELL-GRIER ELECTRIC COMPANY has been formed at Bridgeport, Conn., under the laws of New York State, with a capital stock of $25,000. The officers of the company are: Harvey Hubbell, president; Edward R. Grier, treasurer and manager; Thos. G. Grier, Western manager; Francis E. Laimbeer, secretary. The above-named are also the directors. The company is formed for the purpose of manufacturing the Hubbell electric pull specialties, with a factory at Bridgeport, and New York offices at 93 Nassau Street. Mr. Edward R. Grier, the manager, has been associated with the Bryant Electric Company for the past ten years as their Western manager.

BIG ALLIS ENGINE FOR SYDNEY POWER PLANT.—The Allis-Chalmers Company has just made shipment, from its Milwaukee shops, of another large engine, the third and last for installation in the central power station of the Sydney City & Suburban Tramways, New South Wales, the entire $800,000 contract for the equipment of which, it will be recalled, was secured by the General Electric Company. The engine which has a nominal horse-power of 1500, was loaded on 11 cars. It weighs nearly 200 tons. The bedplate alone weighs nearly 40,000 lbs., and the shaft over 30,000 lbs.

FOREIGN ORDERS FOR HARRISBURG ENGINES.—The Harrisburg Foundry & Machine Works, Harrisburg, Pa., through its New York offices, Mail and Express Building, reports receipt of a number of foreign and domestic orders, received within the last three weeks or so. The orders secured through foreign sources comprise a 40-hp standard engine for direct connection to a General Electric generator for shipment to Porto Rico for lighting purposes. A 25-hp standard belted engine is to be shipped for use in a small lighting plant at Matanzas, Cuba.

ELECTRICAL SUPPLIES FOR ABROAD.—The Manhattan Electrical Supply Company, of 32 Cortlandt Street, New York City, reports receipt of several fair-sized orders for general electrical supplies from various parts of the world, but particularly from South America, Great Britain, British India and Australia. An order for 5000 dry batteries has just been received from London parties and shipments of general supplies are about to go forward to Buenos Ayres, Melbourne, and Calcutta.

ELECTRIC STORAGE BATTERY.—The following changes in the officers of the Electric Storage Battery Company have been made by the directors: Herbert Lloyd, formerly first vice-president, was made president, vice George H. Day, resigned; George D. Widener, formerly second vice-president, was made first vice-president; John R. Williams, formrly third vice-president, was made second vice-president. The office of third vice-president has been temporarily abolished.

AMERICAN EXHIBITION IN LONDON.—The well-known export freight contracting and forwarding house of Alfred H. Post & Co., of New York, Chicago and London, acts as American representatives of the exclusively American exhibition, which is to be held in the London Crystal Palace from May 1 to Nov. 1, 1902. Mr. Alfred H. Post, senior partner of the before-mentioned firm, has been appointed special commissioner in the United States for the exhibition.

HOSPITAL LIGHTING PLANT.—Orders have been placed with the Watertown Engine Company for steam engines for the electric light plant at the Hudson River State Hospital. While the order is not large, it is especially gratifying to the builders, as this makes the tenth engine and the sixth installation of Watertown work in State asylums and hospitals.

THE GEO. C. TOWLE MANUFACTURING COMPANY, of Lancaster, Pa., reports that it is very busy at present in its power motor department. It has just finished several orders of motors for bookbinders' machinery. Its type "E" motors have met with a large sale in that trade. It has also added to its line of motors a new 5-hp. Previous to this month it only made up to 3½ horse-power.

GOULD STORAGE BATTERY COMPANY, of Depew, N. Y., reports a number of recent installation orders, including equipments for the Pratt Institute, Brooklyn; the University of Wisconsin, Madison, Wis.; Cooper Union, New York City, and the New National Bureau of Standards, Washington, D. C.

THE H. P. WHITE COMPANY, LIMITED, of Philadelphia, has recently received orders from the Diehl Manufacturing Company for large switchboards to accompany the light and power plants in the Singer Sewing Machine Company's works at South Bend, Ind., and Cairo, Ill.

THE BUFFALO MANUFACTURING COMPANY, of Akron, Ohio, manufacturer of the Cross oil filters, announces Government orders for two large filters for the battleship "Illinois" and one for the torpedo boat "Bainbridge." Six governments have adopted this filter.

ELECTRICAL APPARATUS WANTED.—The Meyersdale & Salisbury Street Railway Company, of Pittsburg, is in the market for generators, engines, cars, motors, rails, lighting fixtures, wire, etc. Inquiries should be addressed to D. Zinn, lock box 1477, Pittsburg.

General News.

THE TELEPHONE.

PIRU CITY, CALIF.—The Sunset Telephone Company has established a new exchange here.

MARIANNA, FLA.—The Marianna Telephone Company has been incorporated, with $5,000 capital.

TISKILWA, ILL.—A telephone line will be built to Providence this fall.

MONARCH, ILL.—J. A. Smith is erecting an independent telephone line between Bellflower and Saybrook.

EDWARDSVILLE, ILL.—The Kinloch Telephone Company is preparing for active operations in Edwardsville.

ELLIOTSTOWN, ILL.—The Jacobs Telephone Company is extending its line from Eberle to Elliottstown, Winterrowd and Dieterich.

MANHATTAN, ILL.—The Manhattan Telephone Company has been incorporated, with a capital stock of $2,400 by Benjamin J. Baskeville, Dennis Hogan and August Tennyson.

STREATOR, ILL.—The directors of the Independent Telephone Company called a meeting of stockholders for Nov. 19 with a view to increasing the capital stock of the company to $100,000.

ALTON, ILL.—The Central Union Telephone Company has commenced the construction of a new line between Alton and St. Louis. The completion of the line will give four lines between the two cities.

CHICAGO, ILL.—The Chicago Telephone Company has filed an answer to the bill of complaint of the city of Chicago and thirty business men, in which bill the courts are asked to restrain the company from all interference with the telephones of subscribers who offer to pay the rate of $125 a year named in the company's franchise. It makes a general denial of all allegations regarding illegal and excessive rates and sets forth that new inventions and improvements have enabled the company to offer a much better service than that referred to in the ordinance.

BEDFORD, IND.—The City Council of Bedford granted a telephone franchise to James Buddick.

HEBRON, IND.—A new telephone line is being built between Crown Point and Hebron, and will soon be in operation.

TERRE HAUTE, IND.—The farmers of Riley township are forming a mutual telephone company and have asked the County Commissioners for a franchise on the county roads.

SOUTH BEND, IND.—The South Bend Council granted a franchise to the Independent Telephone Company, which is securing much encouragement from business men to locate an exchange there.

BEDFORD, IND.—The City Council has granted a central office franchise to James Ruddick, who has erected a seventy-five mile telephone system, which connects a number of towns of importance.

LAFAYETTE, IND.—George W. Harrison, chief of police of this city, is attracting attention on account of his system of telephonic surveillance in this city and over the entire county. No wrong-doer gets away, it is said.

WASHINGTON, IND.—The City Council has granted the Independent Telephone Company a franchise to establish a system in this city. The new company agrees not to charge for service until it has 300 subscribers, which is said to be more than the present company (the Bell) now has.

FT. WAYNE, IND.—A committee of representative capitalists of this city, engaged in buying and establishing independent telephone exchanges in many Indiana towns, is now touring the State and making examinations. Negotiations are now on for the purchase of the Anderson system as a nucleus for a great system.

SOUTH BEND, IND.—The grant of a telephone franchise to Ft. Wayne capitalists by the City Council is regarded with much interest among citizens of both cities. The new company will make a rate of $24 a year for residences and $36 for business houses, irrespective of distance, which is a 33 per-cent cut in the Bell rates. It will provide the new exchange with the latest improved switchboard, starting with over six hundred connections.

MUNCIE, IND.—Opposition in telephone service is practically assured for this place. The Independent Telephone Company that was refused a franchise by the City Council until it could secure 800 subscribers has readily secured 700, in spite of the active campaign waged by the Central Union. It is said that the City Council, when it refused to consider a franchise until 800 subscribers were secured, thought that would probably end the controversy, but the success of the undertaking is now assured. The new company will be known as the Delaware-Madison Company. It has a plant in operation in Anderson, and hopes to secure franchises in several other neighboring cities.

MT. AYR, IA.—A franchise was granted to the Mt. Ayr Mutual Telephone Company.

SIOUX CITY, IA.—A telephone line is being constructed between Kimball and Platte.

OTTUMWA, IA.—The Ottumwa Telephone Company will build a line to Kirkville to connect with the Union Telephone Company.

NEVADA, IA.—A number of prominent farmers in Milford township have organized a rural telephone exchange which is now being constructed.

LOUISVILLE, KY.—H. A. Bell, sheriff, Louisville, Ky., has presented his report of the sale of twenty-year telephone franchises over the county roads. The purchasers are the Independent Long Distance Telephone Company and the Cumberland Telephone Company.

NEW ORLEANS, LA.—Congressman R. F. Broussard, in speaking of his telephone project, states that New Iberia, his home town, will have 2000 telephones installed, and other towns from 1200 up, and that he has concluded arrangements for 100,000 telephones for New Orleans. No charges are made for installation; only for actual use.

NEW ORLEANS, LA.—The People's Telephone Company will introduce a message rate of two cents. It is claimed that this movement is purely a business one and is not done to bring up the number of subscribers to the number specified in the charter. Several telephones have already been installed on the new basis.

LEWISTON, ME.—The Norridgewock & Fairfield Telephone Company has been organized at Norridgewock, with $100,000 capital stock. E. H. Toby, of Norridgewock, is president.

PORTLAND, ME.—The New England Telephone & Telegraph Company is advertising lower rates in this city, and has installed a few free residence telephones for trial until Dec. 31. This has been brought about, it is claimed, by the competition of the Dirigo Telephone Company. The latter company is extending its system throughout this section of the State.

CUMBERLAND, MD.—The Western Maryland Telephone Company, of Allegheny County, has been incorporated, with a capital stock of $100,000. The principal office will be in Cumberland, Md. De Warren H. Reynolds, Henry J. Glick, of Cumberland, are interested.

BOSTON, MASS.—The Suburban Telephone Company, of Suffolk County, has been incorporated under the laws of Massachusetts, with a capital of $30,000. C. Francis Chisolm is president, A. N. Hooper, treasurer.

IPSWICH, MICH.—A new telephone service is to be installed in this place.

DETROIT, MICH.—The Council Committee on franchises will report favorably on a number of amendments to the franchise of the People's Telephone Company that the latter is seeking.

ANOKA, MINN.—The Minneapolis Telephone Company is building a telephone line from the Twin Cities to Duluth.

WALNUT GROVE, MINN.—The long distance telephone company has decided to put in a local exchange at this place.

LAKE CITY, MINN.—The Dwelle Telephone Company is at work constructing an entire new line between Plainview and Kellogg.

WINONA, MINN.—The Winona Telephone Company has purchased the exchange and toll lines of the Phoenix Company at Rushford.

WEST SUPERIOR, MINN.—A new long-distance telephone line has been opened by the People's Telephone Company of this city to Lake Nebagamon.

MINNEAPOLIS, MINN.—The Rapid Service Telegraph & Telephone Company, of Minneapolis, has filed articles of incorporation. The capital stock is $100,000.

MONTICELLO, MO.—The Citizens' Telephone Company of North Missouri, of Monticello, with a capital of $1,200, has been incorporated, with the following as incorporators: Cyrus C. Rain, Pike Hanna, Charles Seller, and others.

RALEIGH, N. C.—The Interstate Telephone Company will make extensive improvements to its plant in Raleigh. It is now building a line from Raleigh to Angier.

RALEIGH, N. C.—The big water-power plant at Milburnie, near Raleigh, N. C., will soon be ready for operation. Both electric power and light will be furnished to the city of Raleigh. A 900-hp wheel will be used at the plant.

WADESBORO, N. C.—The Bluitt Falls Electric Power Company has been chartered, with offices at Wadesboro, N. C. Mr. F. J. Coxe, of Wadesboro, is interested. The company proposes to develop Bluitt Falls and transmit electric power to Wadesboro and other points. The capital of the new company is $250,000.

ELIZABETH, N. J.—The Interstate Telephone Company has secured franchises at Bradley Beach and Avon.

JERSEY CITY, N. J.—The Brokers' Wire Service Company has been incorporated by W. Benton Crisp and Thomas I. Sinclaire, of 40 Wall Street, and Louis L. Coudert, of Cranford, N. J. The company was organized with a capital stock of $125,000 to furnish brokers with private telephone and telegraph facilities.

BAINBRIDGE, N. Y.—A telephone company has been formed at Union Valley and officers elected.

ALBANY, N. Y.—The Wyoming & Cattaraugus Telephone Company, of Arcade, Wyoming County, has been incorporated; capital, $10,000. Directors: Theodore Hayden, P. E. Merrill and B. B. Lewis, of Sandusky, Cattaraugus County.

GREENSPRING, OHIO.—The Central Union Telephone Company has secured a franchise to operate an exchange here.

CINCINNATI, OHIO.—The City & Suburban Telegraph Association has been very much annoyed through the depredations of wire thieves.

FOSTORIA, OHIO.—The report of the Citizens' Telephone & Message Company for the month of September showed a net increase of 16 4-6 per cent.

CLEVELAND, OHIO.—The Consolidated Telephone Company has commenced work on a line connecting the exchanges at Elmira and Waverley, N. Y., with the main long distance system.

ROSEVILLE, OHIO.—The new exchange of the Roseville Telephone Company has been put in operation, with 100 lines. A toll line from Roseville to Zanesville has been opened.

COOLEVILLE, OHIO.—The Home Telephone Company of Athens County has been incorporated with $5,000 capital stock by H. H. Brown, C. E. Barrows, James Drain, Otto Booth and W. C. Matlack.

CLEVELAND, OHIO.—The properties of the Federal Telephone Company, outside of Cleveland and Columbus, made a gain of over 1100 subscribers and $25,000 in revenues during the month of September.

TOLEDO, OHIO.—The American District Telegraph Company, of Ohio, has asked for a franchise in Toledo to put down conduits, erect poles and string wires. The probate court is asked to grant a perpetual franchise.

BELLEFONTAINE, OHIO.—The Bellefontaine Telephone Company has increased its capital stock from $50,000 to $75,000.

PAINESVILLE, OHIO.—The Painesville Telephone Company has made application to the Council for permission to lay about 20,000 feet of conduit within the fire limits of the town.

MARION, OHIO.—The Central Union Telephone Company will erect a new exchange building in Marion. This is one of the few large towns in Ohio not touched by the independent service. It is stated that an independent company is being formed.

CADIZ, OHIO.—The Harrison County Telephone Company, which is building an exchange at Cadiz, is building toll lines to Dennison and to Steubenville. At Dennison the line will connect with one which the United States Telephone Company is building from Dayton.

CHAGRIN FALLS, OHIO.—The Cleveland Telephone Company has appealed to the Probate Court of Cuyahoga County to secure the granting of a franchise for a system in Chagrin Falls. The town has had a good independent system for many years and the citizens have several times voted against giving the Bell Company a franchise.

TOLEDO, OHIO.—The Empire Construction Company, of Toledo, has been incorporated with $20,000 capital stock by F. W. Wachter, Robert Tucker, Charles D. Sumner, H. M. Barfield and F. F. Graves. The company will make a business of constructing telephone lines and exchanges. The gentlemen interested have contracts to build exchanges in eleven cities and towns.

PLATTSBURG, OHIO.—The Home Telephone Company, of Plattsburg, is installing the Norstrom automatic switchboard and selective party line lockout system. The lockout system is used in connection with party-line telephones and through its use the operator at the exchange permits only two subscribers on a party line to use the line at one time, thus eliminating the chief objection to this class of service.

AKRON, OHIO.—The managers of the Akron exchange of the Central Union Telephone Company and the Akron People's Telephone Company, claim that so far as they are concerned, the strike of the electrical workers is a matter of history. They claim they have all the men they require, but state that some of the old men may have their former places if they desire. The men are confident of winning their demands.

WARREN, OHIO.—The Lane Construction Company, of Warren, has taken a contract to construct a new telephone system at Jamestown, N. Y., for the Home Telephone Company, in which Warren capital is interested. The exchange will be on the central energy system and full metallic copper circuits will be used. A two-story exchange building 25x80 feet is to be erected by the company in the central portion of the city.

CLEVELAND, OHIO.—The Interstate Telephone Company, has elected officers for the ensuing year as follows: W. L. Cary, Jr., president; W. B. Woodbury, vice-president; W. E. Baker, secretary-treasurer. The above, with J. B. Hoge, Maxime Reber, R. E. Enwright and W. T. Hudson constitute the board of directors. The Interstate Company is a constructing company, which builds many of the exchanges controlled by the Federal Telephone Company.

COLUMBUS, OHIO.—Sixty operators at the exchange of the Columbus Citizens' Telephone Company went on a strike Oct. 19. The young ladies ask that their working hours be reduced from 9½ to 9 hours per day, and that a more accurate method of keeping their time than that in vogue be devised. Forty of the girls have formed a labor union, but the company declined to deal with a committee. The difficulty was adjusted temporarily and the girls returned to work pending a final settlement.

BARNESVILLE, OHIO.—The Belmont County Telephone Company, of Barnesville, has affiliated with the Ohio Valley Telephone Company, of Bellaire and the National Telephone Company, of Wheeling, W. Va., for an interchange of service. The Belmont Company connects all the important towns in Harrison and Belmont counties. It is building five lines from Barnesville to Wheeling and Martin's Ferry, and two new lines from Bridgeport to Martin's Ferry. The work of connecting the systems will start as soon as possible.

TOLEDO, OHIO.—The Auglaize Construction Company has been incorporated by J. N. Goeke, Guy Huffman, Frank A. Huffman, A. K. Detwiler and Z. A. Haskins, of Toledo. It will construct and operate telephone exchanges in Ohio, Indiana and Illinois. Interested in the company are State Senator Brorein, T. H. Tracey, George Metzger and George H. Detwiler, as well as the incorporators mentioned. It is the intention to buy up a number of small independent exchanges and toll line companies, to construct others, and eventually to form one large company which will cover extensive territory in the States mentioned. The capital is $10,000.

CLEVELAND, OHIO.—The following statement of three months' business has been issued by the Akron People's Telephone Company, one of the properties controlled by the Federal Telephone Company:

JULY, 1901.

Gross earnings	$4,243.52
Operating expenses	1,971.69
Net earnings	2,271.83
Interest	1,041.66
Surplus	1,230.17

AUGUST, 1901.

Gross earnings	$4,606.22
Operating expenses	2,182.12
Net earnings	2,424.10
Interest	1,041.66
Surplus	1,382.44

SEPTEMBER, 1901.

Gross earnings	$4,670.90
Operating expenses	2,192.98
Net earnings	2,477.92
Interest	1,041.66
Surplus	1,436.26

PHILADELPHIA, PA.—Council at Pine Grove has extended the right of way to the Schuylkill Telephone Company.

CLAYSVILLE, PA.—The Pure Oil Company is building a telephone line rrom Coraopolis, Pa., to Piney Fork, W. Va.

LYKENS, PA.—An ordinance granting permission to the Juniata & Susquehanna Telephone Company to occupy the streets and alleys of the Borough of Lykens with poles and wires has been passed.

HANOVER, PA.—The Hanover Telephone Company will in the near future be merged into the Cumberland Valley Telephone Company, which will also absorb the Dauphin County, the Adams County, the Cumberland Valley Telephone & Telegraph Company, of Chambersburg, and the Southern Pennsylvania Telephone Company, of Carlisle.

SILVERTON, TEX.—A telephone line has just been completed from here to Tulia, and there connects with a line to Amarillo.

SALT LAKE CITY, UTAH.—P. J. Lackner, of the Telluride & Hercules Power Company has petitioned the County Commissioners of Salt Lake County for a franchise to run a telephone line along the county road west of the Jordan River.

RICHMOND, VA.—The Bell Telephone Company, after a long delay, has received a franchise to install a telephone system in Richmond.

UNION, W. VA.—The American Telephone & Telegraph Company has just completed a long-distance line from Lynchburg, Va., to Charleston, W. Va.

RICHMOND, VA.—It is stated that it will cost from $30,000 to $40,000 to place in the conduits of the Bell Company the city fire alarm and police telegraph systems. It seems that during the fight over the Bell franchise this point was overlooked. The franchise as adopted provides that the Bell Company shall give such space to the city wires.

SPOKANE, WASH.—Articles of incorporation have been filed by M. A. Phelps, of Spokane; Joseph Fisher, of St. Maries, Idaho, and Fred. W. Haverland, of Toledo, Ohio, creating the Interstate Telephone Company, with business headquarters at Spokane. The capital stock of the company is fixed at $20,000. The incorporators are also named as directors of the company in the following official capacity: President, Moses A. Phelps; general manager, Joseph Fisher; secretary, F. W. Haverland.

LA CROSSE, WIS.—A new telephone exchange is being organized in Westby, Wis. The new line will connect with the La Crosse and southeastern lines and will have direct connection, with all cities in western Wisconsin. The capital stock of the company will probably be $50,000.

ELECTRIC LIGHT AND POWER.

REDWOOD CITY, CALIF.—The city is illuminated now by the electric current transmitted from Blue Lakes. The cable lines are owned by the Standard Electric Company of California, while the Consolidated Light & Power Company acts as its distributing agent for the county of San Mateo. The latter company now has the contract for lighting the streets of this city and also the city of San Mateo.

SAN FRANCISCO, CALIF.—The Bay Counties Power Company recently again established a new record for the world's longest electric power transmission. Current at 40,000 volts was transmitted from the Colgate generating station thirty-five miles from Marysville, Calif., via the lines of the Bay Counties and the Standard Electric Company to Stockton, Calif. Contracts have been made for commercial purposes, and within a month the Sperry Flour Company's mills and the Stockton Gas & Electric Company will be receiving current.

COLUMBUS, GA.—A deal has been closed here by which George J. Baldwin, of Savannah, and his associates secure a controlling interest in the Chattahoochee Falls Company, of this city. It is understood that they will in the near future improve the property, building a very large electric plant, which will develop about 14,000 horse-power. It will require a stone dam 1600 feet long across the river at this point for the plant. Mr. Baldwin is president of the Columbus Railway Company, of the Savannah Street Railway Company, and also of several other lines owned by the syndicate which he represents.

GREENWOOD, IND.—The Board of Town Trustees has granted a franchise to the American Light Company, of Indianapolis, for a lighting plant to be constructed here.

TERRE HAUTE, IND.—The Board of Managers of the Rose Polytechnic Institute is in New York to purchase a large installment of new electrical apparatus and machinery. A considerable outlay in electrical equipment has been decided upon.

ANDERSON, IND.—The Anderson Water, Light & Power Company, Anderson, Ind., has just finished raising the dam 20 feet, making it 44 feet high and giving a head of 48 feet, which will generate 5000 horse-power. The current will be furnished largely to the Anderson cotton mills.

CROWLEY, LA.—The Crowley Light & Water plant has been advertised for sale to satisfy judgments against the city. The property is valued at about $40,000. Municipal ownership, it is alleged, has proven a failure with the present Council.

NEW ORLEANS, LA.—The United Fruit Company has adopted electric power for unloading vessels and loading cars, and will do away with the Italian hand labor now used for this purpose. It is estimated that it will cut down the time of unloading one-third, the loss and damage to fruit one-fourth, and naturally reduce the expense. It will throw several thousand Italian fruit handlers out of work.

ST. LOUIS, MO.—By direction of the Harbor Commissioner, pipes laid by the Laclede Power Company, connecting its plant at Main and Ashley Streets with the river, were taken up. The pipes were laid on a permit for a drain, but were intended to be used for supplying the Laclede Power plant with water from the river. It is stated the matter will be taken into court.

WEBSTER GROVE, MO.—The St. Louis Electrical Construction & Maintenance Company has informed the Board of Aldermen that the electric light plant will be in operation by Nov. 1, and action has been deferred until that time by the aldermen. The city has been without light for two months, owing to the drying up of the River des Peres. It is now proposed to erect a new power-house at Brentwood.

VAN WERT, OHIO.—The plant being installed by the Van Wert Gas-Electric Light & Power Company will be put in operation within a few days.

CINCINNATI, OHIO.—The Cincinnati Edison Company has broken up a plan whereby many persons have been securing current practically free. Connections were made to shunt the current around the meter.

COLUMBUS, OHIO.—The municipal lighting plant is again in operation after a year of idleness. The plant will furnish current for 315 arc lights, while the Columbus Electric Company will furnish about 650 lights.

ROSEBURG, ORE.—The Douglas Electric Company has been incorporated with Roseburg, Ore., as the principal place of business. Directors: L. A. Walker, Mrs. M. Josephson and F. W. Benson. Capital stock, $6,000.

TOLEDO, OHIO.—The Toledo Lighting & Heating Company will erect lighting and heating plants at Coshocton, and Bowling Green, Ohio, Bloomington, Ind., and Findlay and Oak Park, Ill. The last mentioned plant will be a very large one.

CINCINNATI, OHIO.—Articles of incorporation of the Cincinnati & Suburban Light, Gas & Electric Company have been filed at Columbus. The capital stock is $10,000. It is intended to secure franchises in villages and towns surrounding Cincinnati.

CINCINNATI, OHIO.—The Cincinnati Gas & Electric Company has gone into the courts for protection against what appears to be an organized gang of vandals. Hundreds of electric light globes have been broken, the damage last month alone being $1,500.

SALT LAKE CITY, UTAH.—The Telluride Power Company has started to string wire on poles erected as far south as Farmington.

SALT LAKE CITY, UTAH.—The surveys for the double reservoirs of the Raft River Power Company have been completed, and construction will commence at once. The company will be prepared to furnish light and power early in the Spring.

SALT LAKE CITY, UTAH.—The waters of Shoshone and American Falls, Idaho, will be utilized for power purposes. Two companies are in the field, both trying to avoid publicity until their plans are further advanced. They are the Twin Falls Land & Water Company and the J. H. Brady Company. Engineer Gates of the Brady Company is busy in Salt Lake in connection with the entrance of the lines into Salt Lake City.

SALT LAKE CITY, UTAH.—The American Falls Power, Light & Water Company, which was recently incorporated at Pocatello, Idaho, will install within the next six months two 750-kw generators and two water wheels that will develop, theoretically, 1600 horse-power each. The company has bought about half of the number of poles required for the transmission line, and is now figuring with two different concerns for its electrical equipment. It will have its plant completed and the power ready to deliver at Pocatello, a distance of 25 miles, and to Blackfoot, a distance of 46 miles, by July 1, 1920. A notice of the organization of this company was published in a recent issue of this paper. Mr. J. H. Brady is president, and A. V. Scott secretary.

ROANOKE, VA.—The contract has been awarded by the Roanoke cotton mills for the installation of an electric lighting plant.

NORFOLK, VA.—The Norfolk Heat, Light & Power Company, which is owned by Philadelphia capitalists, has its new plant well under way to completion.

TWO RIVERS, WIS.—The city of Two Rivers is about to experiment in the matter of municipal ownership of waterworks and electric lighting plants. The city will start out with up-to-date plants in every respect.

THE ELECTRIC RAILWAY.

HUNTSVILLE, ALA.—Local capitalists are surveying a line from Huntsville to the top of Monte Sano. It is proposed to convert the old dummy road into an electric line. While no contracts have been let, it is understood that work will commence in November.

DENVER, COLO.—The management of the Colorado Southern Railway has decided to use electric traction on its suburban lines running out of Denver. The third rail system will be adopted.

ANDERSON, IND.—All the right of way has been secured for the Muncie, Middletown & Greenfield Traction Company.

NATCHEZ, MISS.—W. A. Percy, of Memphis, Tenn., representing Memphis and other capitalists, has completed preliminaries to a contract for the building of an electric railway system in Natchez.

STEVENSVILLE, MONT.—A franchise has been granted to G. T. Baggs to construct an electric railway here.

HENDERSONVILLE, N. C.—It is reported that an electric railway is to be built to Flat Rock, in the mountain section of western North Carolina.

PENN YAN, N. Y.—Plans are under way for an extension of the Geneva, Seneca Falls & Waterloo Electric Road from Geneva to this village, via Halls Corners.

NORTHPORT, L. I.—This place is to be connected by trolley with the East Northport station of the Long Island Railroad, a distance of two and seven-tenths miles. Upon the request of the people of Northport, the railroad company has agreed to construct the line. All necessary franchises, so far as the town is concerned, have been granted, and the plans for the new line are now before the State Railroad Commissioners for their approval.

ALBANY, N. Y.—The Salamanca & Little Valley Railroad Company has been incorporated, with a capital of $400,000 to construct an electric road fourteen miles long, connecting Salamanca and Little Valley, Cattaraugus County. The directors are A. E. Darrow, F. E. Kelly and T. Champlin, of Little Valley; Hudson Ansley, Fred. R. Adams and Edward Bolard, of Salamanca; Thomas Lathrop, Clifford Hubbell and John S. Rockwell, of Buffalo.

NEWARK, OHIO.—The Newark Council has granted a franchise through town to the Columbus & Granville Electric Railway.

ELYRIA, OHIO.—The Elyria, Grafton & Southern Electric Railway, a branch line of the Cleveland, Elyria & Western system, is now in operation.

GENEVA, OHIO.—The Geneva Council has passed an ordinance granting a franchise through the town to the electric railway building from Painesville to Ashtabula.

MANSFIELD, OHIO.—The Mansfield, Savannah & Wellington Railway Company has filed a mortgage for $1,500,000 in favor of the North American Trust Company, of New York City.

CANTON, OHIO.—The Canton, Lodi & Medina Railway Company has been organized to build a line from Canton to Medina. W. W. Irwin, Wm. Wagner, J. J. Whiteacre and John Harmony are the promoters.

CINCINNATI, OHIO.—The Lebanon & Franklin Traction Company, of Lebanon has been incorporated with $10,000 capital stock by Chas. H. Bosler, S. E. Kemper and A. G. Kennedy, of Dayton and V. J. A. Obenauer and Robert H. Kline.

MORROW, OHIO.—The Cincinnati, Lebanon & Dayton Traction Company has been incorporated, and the company guarantees the road to be in operation between Cincinnati & Lebanon on or before July 1, 1902. Wade Cushing, of Cincinnati, is president.

CLEVELAND, OHIO.—The title of the Little Miami Traction Company has been changed to the Springfield & Xenia Traction Company. The line will be in operation from Springfield to Xenia before the first of the year. Later it will be extended to Cincinnati.

STEUBENVILLE, OHIO.—The Steubenville, Mingoe & Ohio Valley Traction Company, which is extending its line from Steubenville to Brilliant, has made arrangements for through traffic to Wellsburg, W. Va., by means of a ferry across the Ohio River. The road is nearly completed.

CINCINNATI, OHIO.—Peter and Philip Swing, promoters of the Cincinnati & Columbus Traction Company announce that all rights of way and franchises for the line have been secured, and that ground will be broken in the near future. The road will extend from Madisonville to Washington C. H.

COLUMBUS, OHIO.—The Columbus Railway Company has declared a quarterly dividend of 1¼ per cent on its capital stock to its employes, payable Nov. 1. On the same date the stockholders will receive a similar dividend. This will make the ninth dividend the company has declared to its 500 employes.

SPRINGFIELD, OHIO.—Engineers C. A. Alderman and D. H. Ullery, of the Dayton, Springfield & Urbana Traction Company, have completed the plans for the new power-house to be located at Medway. The work will be started at once. There will be three rotary converters between Medway and Columbus.

CLEVELAND, OHIO.—The past year has been the most prosperous in the history of the Cleveland City Railway Company. It is reported that the directors will retire the company's bonds, and thus clear off all its indebtedness, and that to this end about 3 per cent of the net earnings will be used as a sinking fund and the remaining dividend will be 6 per cent for stock.

WEST MILTON, OHIO.—W. E. Gear, of Boston, general manager of the Dayton, Covington & Piqua Traction Company, has submitted the plans for the power-house, car barn, and depot to be built at this place. The power-house will be 50x100 feet. A pumping station will be built on the bank of the river. The capital of the company has been increased from $50,000 to $1,150,000.

TOLEDO, OHIO.—The Toledo Board of Public Works has adopted a resolution to grant no new franchise or extension of any existing franchise to the Toledo Railways & Light Company, until such time as the company shall concede universal transfers, with at least six tickets for twenty-five cents. The company has been refused permission to build a switch to connect with its power-house.

CLEVELAND, OHIO.—The officers of the Sandusky & Interurban and the Sandusky, Norwalk & Southern at Sandusky, the Toledo, Fremont & Norwalk at Fremont will soon be removed to Cleveland, and all four lines constituting the Lake Shore Electric Railway, will be handled from the general offices in the Electric Building. General Manager Danforth and general superintendent Stout will both make their headquarters at and reside in Cleveland.

TOLEDO, OHIO.—The Ohio Supreme Court at Columbus is hearing arguments in the case of the Toledo & Maumee Valley Railway vs. the Toledo Traction Company, the Toledo Consolidated Street Railway and the Metropolitan Street Railway. The plaintiff in error seeks to compel the other companies to receive and permit its cars to run over the tracks under a certain contract agreement. All of the roads mentioned are now owned by the Everett-Moore syndicate and the case is being carried up as a test.

ZANESVILLE, OHIO.—The Columbus, Newark, Zanesville & Wheeling Traction Company, has been organized with the following officers: President, J. M. Ickes; vice-president, John S. Black; treasurer, W. O. Little; secretary, L. F. Taylor. The road will extend from Columbus to Wheeling, touching Newark, Zanesville and Cambridge, and there will be a branch line to Coshocton. It will be constructed in a very substantial manner with a view to hauling freight and passengers at high speed in competition with steam roads.

HARRISBURG, PA.—Charters have been issued by the State Department to the following corporations: Ruth Street Railway Company, Pittsburg; capital, $12,000. Duquesne Heights Street Railway Company, Pittsburg; capital, $18,000. George W. Wilson, of Pittsburg, is president of both companies.

PITTSBURG, PA.—The Pittsburg, McKeesport & Connellsville Electric Railway Company has prepared plans and specifications for a new car shop, which is to be erected at New Haven, Pa., at a cost of $50,000. The building will be constructed of brick and steel, and its dimensions will be 80x200 feet. The main power house of the road will be located near the car shop, and bids for the construction of the former will soon be asked for. The electrical equipment of the road has already been contracted for with the Westinghouse Electric & Manufacturing Company, of this city.

THE AUTOMOBILE.

N. J. AUTOMOBILE COMPANY.—Vice-Chancellor Stevens has appointed Samuel P. Lever receiver for the New Jersey Automobile Company, which has an office in Jersey City.

MR. H. WARD LEONARD has recently prepared and issued a very complete general specification for a gasolene motor car drawn in the light of a recent experience and following closely the features of design characteristic of the motor cars which made the best showing in the recent Paris-Bordeaux and Paris-Berlin races.

PRIZE CUPS were presented at the meeting of the Automobile Club of America, at its meeting on Oct. 22, to the three winners in the hill climbing contests at Nelson Hill, New York. They were three handsome silver vases. An interesting evening was spent, the topic being experiences in the New York-Buffalo endurance test.

SPEED RECORD.—All automobile records from one to ten miles were broken at the Grosse Pointe racetrack, Detroit, on Oct. 24, by Alexander Winton, of Cleveland, who covered a mile on his big racing machine in 1:06⅗, lowering Henri Fournier's record by two-fifths of a second, which the latter made on the Empire City track Oct. 10. Winton covered ten miles in 11:09 flat, and three times during the afternoon clipped two-fifths of a second from Fournier's mile record. The mark of 1:06⅗ was caught three different times by expert timers, and it is the fastest mile ever made on any track by any manner of vehicle. The time for ten miles was 11 minutes.

A SPECIAL TRIP.—The automobile department of the American Bicycle Company started a Toledo steam carriage from its Toledo, Ohio, factory on Monday, Oct. 14, on an endurance run to New York, it being the intention of the automobile department to have the wagon demonstrate the practicability of an automobile for touring work. The carriage alone weighs between 1400 and 1500 pounds. The weight of the two occupants will be about 150 and 250 pounds apiece, making a total weight of about 400 pounds. This with their luggage, would bring the combined weight of the carriage and occupants up to about 2000 pounds, which weight it is believed will be the maximum limit for any two-seated touring vehicle. The carriage is to be on view at the New York Automobile Show next week.

AUTOMOBILE EXHIBITORS AT MADISON SQUARE GARDEN.—The following manufacturers are among those who have secured space at the Second Annual Automobile Exhibition, to be held Nov. 2 to 9, in the Madison Square Garden in New York City, under the auspices of the Automobile Club of America: Mobile Company of America, Tarrytown-on-Hudson, N. Y.; Winton Motor Carriage Company, Beldon and Mason Streets, Cleveland, Ohio; Electric Vehicle Company, 100 Broadway, New York; Baker Motor Vehicle Company, Central Avenue and C. & P. R. R., Cleveland, Ohio; Peerless Manufacturing Company, Lisbon Street, Cleveland, Ohio; Locomobile Company of America, 7 East 42d Street, New York; Autocar Company, Ardmore, Pa.; Automobile Company of America, 135 Broadway, New York; Overman Automobile Company, 81 Fulton Street, New York; Haynes-Apperson Company, Kokomo, Ind.; American Bicycle Company, Park Row Building, New York; De Dion-Bouton Motorette Company, Church Lane and 37th Street, Brooklyn, New York; The George N. Pierce Company, 18 Hanover Street, Buffalo, N. Y.; Pan-American Motor Company, Mamaroneck, N. Y.; United States Long Distance Automobile Company, 307 Whiton Street, Jersey City, N. J.; Knox Automobile Company, Waltham Avenue, Springfield, Mass.; Geneva Automobile & Manufacturing Company, Geneva, Ohio; Automotor Company, Box 1073, Springfield, Mass.; Desberon Motor Car Company, 51st Street and 12th Avenue, New York; Holland Automobile Company, 60 Van Winkle Avenue, Jersey City, N. J.; Century Motor Vehicle Company, 517 East Water Street, Syracuse, N. Y.; Ward Leonard Electric Company, Bronxville, N. Y.; Ohio Automobile Company, Warren, Ohio; D. B. Smith & Company, Genesee and Broad Streets, Utica, N. Y.; Duryea Power Company, Reading, Pa.; Steamobile Company of America, Keene, N. H.; Foster Automobile Manufacturing Company, 297 State Street, Rochester, N. Y.; Lane Motor Vehicle Company, Poughkeepsie, N. Y.; Loomis Automobile Company, Westfield, Mass.; Diamond Rubber Company, Akron, Ohio; Joseph Dixon Crucible Company, 68 Reade Street, New York; Charles E. Miller, 97 Reade Street, New York; Janney, Steinmetz & Company, Drexel Building, Philadelphia, Pa.; Dow Portable Electric Asst. Company, 218 Tremont Street, Boston, Mass.; New York Belting & Packing Company, 25 Park Place, New York; Gleason-Peters Air Pump Company, Mercer and Houston Streets, New York; Midgley Mfg. Company, Third and Naughton Streets, Columbus, Ohio; R. E. Dietz Company, 60 Laight Street, New York; American Ball Bearing Company, Central Avenue and C. & P. R. R., Cleveland, Ohio; John Simmons Company, 110 Centre Street, New York; Goodyear Tire & Rubber Company, Akron, Ohio; Standard Welding Company, Central Avenue and Cone Street, Cleveland, Ohio; Buffalo Gasoline Motor Company, Dewitt and Bradley Streets, Buffalo, N. Y.; Shelby Steel Tube Company, 258 Broadway, New York; Vehicle Equipment Company, 38 Nassau Street, New York; Hydra Double Battery Company, 32 Broadway, New York; International Automobile & Vehicle Tire Company 346 Broadway, New York; Rose Manufacturing Company, 910 Arch Street, Philadelphia, Pa.; Munger Vehicle Tire Company, New Brunswick, N. J.; Gray & Davis, Amesbury, Mass.; B. F. Goodrich Company, 66 Reade Street, New York; Veeder Manufacturing Company, Hartford, Conn.; Automobile Supply Company, 310 Mott Avenue, New York; Grant-Ferris Company, Troy, N. Y.; Baldwin Cycle Chain Company, Worcester, Mass.; Consolidated Rubber Tire Company, 1784 Broadway, New York; Porter Battery Company, 1023 Monadnock Block, Chicago, Ill.; Metallic Rubber Tire Company; 210 Centre Street, New York; Badger Brass Manufacturing Company, Kenosha, Wis.; Hartford Rubber Works Company, Hartford, Conn.; Robinson Motor Vehicle Company, 175 Devonshire Street, Boston, Mass.; Searchmont Motor Company, 1230 Orkney Street, Philadelphia, Pa.; Crest Manufacturing Company, 83 Portland Street, Cambridge, Mass.; Upton Machine Company, 17 State Street, New York; Steam Vehicle Company, Reading, Pa.; Stearns Steam Carriage Company, Syracuse, N. Y.; Smith & Mabley, New York.

NEW INDUSTRIAL COMPANIES.

THE ELECTRICAL & CHEMICAL MANUFACTURING COMPANY, of New York, has been incorporated, with a capital of $1,000.

THE STOREY MOTOR & ELECTRIC COMPANY has been incorporated in New Jersey; capital, $500,000. Incorporators: S. Livingston, Frederick Weiner and Rupert A. Jenks.

THE NEW YORK SWITCHBOARD & MANUFACTURING COMPANY, of New York City, has been incorporated, with a capital of $4,000. Directors: Ernest Ohnell, Peter Gran and A. P. Anderson, of New York.

THE ELECTRIC FURNACE COMPANY, of New York City, has been incorporated, with a capital stock of $200,000, to manufacture potash, carbide and steel. The directors are Theron Davis, Thomas Seelye and Wm. N. Barry, of New York City.

THE MONARCH ELECTRIC COMPANY, of Baltimore, Md., has been incorporated by Messrs. Walter Raymond Carpenter, Raleigh T. Lilley, Frank M. Walton, Clarence D. Boyle and Thomas Ireland Elliott for the purpose of manufacturing and dealing in electrical supplies and appliances. The capital stock is $2,000.

THE EL PASO ELECTRIC COMPANY has been incorporated under the laws of New Jersey. It is a combination of a number of electrical concerns in Texas, and will have a capital of $1,250,000. The incorporators are Henry B. Sawyer, John W. Hallowell, J. Harold Oakes, Benjamin H. Dibblee, Owen W. Young and James B. Dill.

THE TABASCO AGRICULTURAL COMPANY was recently incorporated in San Francisco, Calif. Its objects are to deal in lands, telephone lines, telegraph lines, railroads, automobiles and "everything else in the Philippines and elsewhere." Capital stock, $100,000. Directors: G. B. Ingram, Peter Bacigalupi, R. H. Warfield, J. Dalzell Brown, C. T. Michaels, Dr. C. J. Teass, Howard Perrin, J. F. Burgin, Fred H. Colburn, Joseph Naththaly and C. F. Curry.

LEGAL.

RIGHT TO USE TRADE NAME.—In the suit of the Babcock & Wilcox Company against the Joshua Hendy Machine Works a decree has been entered in the United States Circuit Court for the Northern District of California, enjoining the defendants by perpetual injunction from using the name "Babcock & Wilcox" either alone or combined with other word or words upon or in connection with the sale or offering for sale of any boiler or other steam apparatus not manufactured by the complainant and from stating or representing that any boiler or other steam apparatus sold or dealt in by the respondent and not manufactured by complainant as a Babcock & Wilcox boiler, and from selling or offering for sale, or passing off any such boiler or other steam apparatus, as and for boilers or steam apparatus manufactured and sold by complainant. The court holds that the complainant has acquired all over the world an exceedingly high and valuable reputation under the name of "Babcock & Wilcox,' and is the sole and exclusive owner of such trade name.

ILLIONIS CORPORATION TAXES.—The Supreme Court of Illinois has affirmed the judgment of the Circuit Court of Sangamon County in what is known as the Chicago Teachers' tax case. This in effect awards a writ of mandamus against the State Board of Equalization to compel it to assess the capital stock, including franchises, of twenty Chicago corporations, the cash value of whose capital stock, including franchises, over and above the value of their tangible property, is alleged to aggregate $235,000,000. The following are the corporations directly affected: Chicago City Railway Company, West Chicago Street Railway Company, North Chicago Street Railroad Company, Chicago Union Traction Company, People's Gas Light & Coke Company, Chicago Telephone Company, Chicago Edison Company, Chicago Consolidated Traction Company, Chicago Electric Transit Company, Chicago & Jefferson Urban Transit Company, Evanston Electric Railway Company, Cicero & Proviso Street Railway Company, North Chicago Electric Railway Company, North Side Electric Street Railway Company, Ogden Street Railway Company, Chicago, North Shore Railway Company, South Chicago City Railway Company, Chicago, West Division Railway Company, Chicago Passenger Railway Company, and North Chicago City Railway Company. The case will be appealed.

OBITUARY.

MR. EDWARD C. LEWIS, aged seventy-five years, president of the Farrell Foundry & Machine Company of Waterbury, Conn., and prominently interested in twenty-six other manufacturing concerns in Waterbury and Hartford, died on Oct. 24. Mr. Lewis was the Republican nominee for Congress from the Second Connecticut District in 1886.

MR. JOHN WHIPPLE, JR., son of John Whipple, the well-known real estate agent of Newport, died at Leesburg, Va., last week. The deceased had been located in Virginia for a number of years, being engaged there in the electric light business. The deceased was about forty years old, and leaves a widow. He was the grandson of the late Thomas Swann, who was Governor of Maryland.

MR. Z. S. HOLBROOK, of Brookline, Mass., died suddenly Wednesday night, Oct. 23, after a surgical operation. He recently resigned as president of the Massachusetts Telephone & Telegraph Company, to be president of the American & Moore Electrolytic Companies. Mr. Holbrook attended the Yale Theological School. He left the ministry in 1881 and became engaged in business. For some time past he has been active in the independent telephone movement in New England.

DR. JOHANN GEORG VON SIEMENS, founder and former director of the Deutsche Bank and a leading member of the Reichstag and the Prussian Diet,

who had been seriously ill for several weeks, died in Berlin on Oct. 23. This eminent German financier was a native of Torgau, where he was born in 1839. He was educated at Heidelberg and Berlin, and began the practice of law at an early age. His practice was interrupted by the campaigns of 1864, 1866, and 1870, from which the young lawyer-volunteer emerged as a lieutenant, with the order of the Iron Cross, given only for distinguished bravery in action. When the Deutsche Bank was started, in 1871, Dr. von Siemens, though only thirty-one, was selected to manage it. This he did for thirty years, retiring in 1900, after a career marked by great financial talent and capacity for leadership. He widened the bank's business enormously, and at last raised it to a position where its influence is worldwide. Under him the bank floated, or aided to float, loans from nearly all the countries of the civilized world, and it established connections in all important commercial centers. Notable among its operations in America was the financing of the Northern Pacific Railroad, and its participation in the reorganization. Since his retirement, Dr. von Siemens had been a trusted adviser of the bank. He had within a year been regarded as a possible selection for Finance Minister of the German empire, a post for which his qualities would have eminently fitted him. Dr. Siemens was a cousin of the earlier men of that name, and his father made an advance, it is said, of 6,000 thalers to Dr. Werner von Siemens, when the latter, a young artillery officer in the German army, started his famous electrical works in association with Halske. Dr. Georg was always interested in the celebrated concern conducted by his relatives, and was also interested in the development of the important electrical corporation known as the Allgemeine Elektricitäts Gesellschaft. The joint record of the Siemenses in modern science, modern finance and modern engineering is probably without parallel during the last century.

PERSONAL.

MR. H. C. PATTERSON, superintendent of the municipal water works, electric light and power plant of the city of Austin, Tex., resigned on Nov. 1, in order to take up other work.

MR. W. S. BARSTOW was one of the hard-working jurors on class 10 at the Pan-American Exposition, and our attention has been called to the fact that his name was omitted from the report of awards given in this journal of Oct. 19.

MR. EDWARD CALDWELL has sold his interest in the Trade Paper Advertising Agency, of which he has been president, and has no longer any connection with it. His office is at room 1221, American Tract Society Building, this city.

MR. A. V. ABBOTT, formerly chief engineer of the Chicago Bell Telephone Company, has become associated with the Century Telephone Construction Company, and the Consolidated Telephone Company, of Cleveland, and will have charge of much of their installation work at exchanges being installed in New York State. Mr. Abbott has a widespread reputation in the electrical field.

MR. H. H. ROBINSON, for many years traffic manager of the Central Union Telephone Company, with headquarters at Chicago, has resigned to accept a similar position with the United States Telephone Company, succeeding K. V. Murry, who recently resigned. Mr. Robinson has had long experience in the traffic work of the long-distance telephone business, and is a valuable acquisition to the United States Company's forces.

MR. DE WITT C. TANNER, who for seven years has been connected with the office of Geo. P. Barton, patent attorney, of Chicago, has become a partner in the business, and the firm name will hereafter be Barton & Tanner, with offices in the Monadnock Block, as heretofore. Mr. Tanner has made many friends among the electrical fraternity in Chicago, and was one of the prime movers in the selection and publication of the well known set of standard conventional diagrams of electrical apparatus, published by the Chicago Electrical Association some time ago.

PROF. WILLIAM S. ALDRICH, late of the University of Illinois, has entered upon his duties as Director of the Thomas S. Clarkson Memorial School of Technology, Potsdam, N. Y., which position he was tendered and accepted several months ago. Among other recent appointments to the staff of the Clarkson School are Prof. Edwin Haviland, Jr., B. S. (Swathmore), M. A. (Cornell), who will occupy the chair of civil engineering, and Mr. W. S. Graffan, B. S. (Worcester Polytechnic Institute), who has been appointed superintendent of shops.

MR. R. N. KING, formerly with the Stillwell-Bierce & Smith-Vaile Company, has established an office at 35 Wall Street, New York, and is pushing plans for the development of 30,000 horse-power in Nebraska. It is proposed to build a canal 30 miles in length from Linwood on the Loup River to Fremont on the Platte River. This canal will carry the waters of the Loup River through a natural formation into a reservoir on the Elm Creek cañon, at Fremont, Neb., where the bluffs rise 200 feet above the Platte River. It is also proposed to consolidate the street car and electric lighting interests of Omaha and Council Bluffs and vicinity. Reference to this scheme was made in these pages some weeks ago, upon its first rumor.

MR. WILLIAM H. BROWNE, general manager of the Royal Electric Company, of Montreal, Can., has sent in his resignation of the position, to take effect in three months. Mr. Browne went from New York to Montreal in 1893, and took over the management of the Royal Electric at a time when its fortunes were considered to be at a low ebb, and when the need was felt of the presence of a strong man at the head of affairs. The success of the new management was quickly recognized, and the extent of that success may be inferred from the statement, made by insiders to-day, that the stock of the concern is now between four and five times as valuable, all intervening operations considered, as it was when he took hold. Mr. Browne's next movements will be a matter of much interest to a host of friends.

NEW INSTITUTE MEMBERS.—Following are the names of the new members of the American Institute of Electrical Engineers elected this month: William L. Abbott, chief operating engineer, Chicago Edison Company, 139 Adams Street. Harry Bartlett Alverson, superintendent, Cataract Power & Conduit Company, Buffalo, N. Y. Charles Gilman Atkins, engineer on power business, Chicago Edison Company, 139 Adams Street, Chicago, Ill. Willard S. Atkinson, electrical engineer and factory manager, Zimdars & Hunt; R. F. D. No. 5, New Brunswick, N. J. William Childs Bamber, electrical engineer, Rapid Transit Subway Construction Company. Willard S. Bennett, the S. S. White Dental Mfg. Co., New York City. Robert G. Brown, electrician, 158 Montague Street, Brooklyn, N. Y. Arthur Clifford Bunker, engineering department, Stanley Electric Manufacturing Company, 238 Crocker Building, San Francisco, Calif. Willard Gilbert Carlton, assistant to chief operating engineer, Chicago Edison Company, 139 Adams Street, Chicago, Ill. Henry Cannon Carpenter, assistant in engineering department, New York Telephone Company. Oliver Francis Conklin, consulting electrical engineer, the Robbins & Myers Company, Springfield, Ohio. Frank Powell Cox, electrical engineer, General Electric Company, Lynn, Mass. Louis Aloysius Ferguson, general superintendent, Chicago Edison Company, 139 Adams Street, Chicago, Ill. Harry Barnes Gear, general inspector, Chicago Edison Company, 139 Adams Street, Chicago, Ill. Grenville A. Harris, electrical and mechanical engineer, Takata & Company, 10 Wall Street, New York City. John Allen Heany, expert, Peter Heany Development Company, 904 Quarry Street, Philadelphia, Pa. Charles Janisch, chief engineer, the Siemens & Halske Company; Siegmunds No. 12, Berlin, Germany. Peter Junkersfeld, assistant to mechanical engineer, Chicago Edison Company, 139 Adams Street, Chicago, Ill. Paul John Kruesi, assistant to sales manager, General Incandescent Arc Light Co., 572 First Ave., New York. Geo. Holt Lukes, night operating superintendent, Chicago Edison Company, 139 Adams Street, Chicago, Ill. Godfrey Morgan, general manager the Niagara Gorge Railroad Company. Homer Eldredge Niesz, assistant to general superintendent, Chicago Edison Company, 139 Adams Street. Alonso D. Palmer, superintendent, Compania Anonima de Redes Telefonicas de Ponce, box 135, Ponce, Porto Rico. Granville Ernst Palmer, salesman, H. C. Roberts Electrical Supply Company, 802 Equitable Building, Baltimore Md. Samuel Newton Smith, manager of sales, Submerged Electrical Motor Company, 725 Temple Court, Minneapolis, Minn. Ralph Sweetland, electrical inspector, New England Insurance Exchange, 55 Kilby Street, Boston.

EDUCATIONAL.

THE YOUNG MEN'S CHRISTIAN ASSOCIATION, of Cleveland, will conduct, in connection with its educational features, a school of telephony. Messrs. R. C. Gifford and T. J. Tune, both expert in telephone construction work, will conduct the class.

THE CONSOLIDATED SCHOOLS have been opened at 156 Fifth Avenue, New York, in charge of Mr. Ewald. These schools, formerly known as the United Correspondence School, the Institute of Home Study of Engineering and the Correspondence School of Technology, have recently changed hands.

Trade Notes.

THE BURT MANFACTURING COMPANY, of Akron, Ohio, has just entered its tenth order from the Pittsburg Plate Glass Company, for Cross oil filters.

HYLO LAMPS.—Messrs. F. B. Sage & Bro., 123 Liberty Street, New York, announce that they are now the agents in New York City and vicinity for the Hylo lamps.

THE ELECTRIC APPLIANCE COMPANY, Chicago, is sending out a complete descriptive circular, giving cuts and prices of the Newgard waterproof receptacle in the various styles in which it is made.

THE VARLEY DUPLEX MAGNET COMPANY has moved the office of its Western Agent, C. L. Hibbard, to 82 Lake Street, Chicago, Ill., and all inquiries and orders for its well known products will receive prompt and careful attention.

JENKINS BROS., 71 John Street, New York, have received the following awards at the Pan-American Exposition at Buffalo, for their goods: Gold medal for Jenkins Bros. valves; gold medal for Jenkins '96 packing; two silver medals for rubber specialties.

THE WOODS MOTOR VEHICLE COMPANY, of Chicago, suffered a loss by fire in its factory at 549 Wabash Avenue the evening of Oct. 25. Twenty-two automobiles and a number of patterns and parts were lost, making a total loss to the company, which is given as $75,000.

AUTOMOBILE SUPPLIES.—Mr. A. L. Dyke is sending out a batch of pamphlets describing and illustrating the line of automobile supplies and parts handled by him. All those interested in automobiles would do well to communicate with Mr. Dyke, whose headquarters are in the Linmar Building, St. Louis, Mo.

CAR TRUCKS.—In a recent catalogue issued by the J. G. Brill Company, Philadelphia, Pa., is very completely described the construction of the No. 27 truck in its various forms. These trucks are used both on street and steam railways. The catalogue includes several pages of testimonial letters regarding the truck.

CASTINGS.—Telephone, dynamo and motor castings are made a specialty of the business of the John Reek Electrical Works, Camden, Mich. The concern also makes dynamos and motors complete, and a recently issued catalogue gives prices and descriptions of the various machines manufactured by it, besides a full line of electrical supplies.

ELECTRICAL AND STEAM MACHINERY.—Messrs. Rossiter, MacGovern & Company, 141 Broadway, New York City, in their October circular give a list of electrical and steam machinery for railway, lighting and power purposes, on hand ready for prompt shipment. The list includes many makes of machines, street cars, boilers, condensers, engines, etc.

POWER PUNCHING MACHINERY.—The Long & Allstatter Company, Hamilton, Ohio, describe and illustrate in a 160-page catalogue its complete line

of power punching and shearing machinery. The standard machines of this company are made single and double in form, with throats in depth between 4 inches and 72 inches. The machines are very finely illustrated.

THE INCANDESCENT ELECTRIC LIGHT MANIPULATOR COMPANY, which received the highest award in its line (bronze medal) for its manipulators and Morse adjuster at the Pan-American Exposition, reports that the call for samples of its Morse automatic adjuster, from mills, factories and shops in all parts of the country far exceeds its anticipation. And although this is its first season on the market, the orders are more than satisfactory.

THE WESTERN ELECTRICAL SUPPLY COMPANY, of St. Louis, reports that it is meeting with unusual success with its new type Scheeffer recording wattmeters. It states that this apparatus has been recently improved, and that it now has a meter which gives an absolutely correct record, is sensitive to the highest degree, and the most economical meter on the market. The company has gotten out a pamphlet fully describing these instruments, together with prices and full information on them, which is mailed on application.

THE TRIUMPH ELECTRIC COMPANY, of Cincinnati, Ohio, issues a 6½ by 9½ pamphlet of 60 pages, containing neat half-tone cuts showing the various patterns and types of electric generators and motors that it manufactures, also the construction of armatures, field coils, brush holders, commutators, etc. The direct-connected generators are of the "Standard" engine type and the "Marine" type. As showing the wide range of work for electric motors, a cut is given of one direct connected to a 500-lb. hammer and of another direct geared to an egg-beater.

DYNAMOS AND MOTORS.—The Star Dynamo Works, Jefferson City, Mo., are making a line of small and medium sized electric motors and dynamos, a specialty of the business being the furnishing of complete incandescent lighting plants with directions for erecting, so that any one with slight mechanical ability can install and operate such a plant satisfactorily. The company will be glad to send to any one interested complete lists covering the different outfits furnished by it. The specifications include plants of 15 lights, 25 lights, 50 lights and 100 lights. The company has been making this apparatus for several years past and has established a record for its work.

KEYSTONE ELECTRICAL APPARATUS.—The Keystone Electric Company of Erie, Pa., is manufacturing a line of dynamos and motors ranging from 9 to 180 kilowatts as generators, and 11½ to 240 horse-power as motors. These machines are recommended for general power and lighting service, and, it is stated, are constructed to satisfy the most exacting requirements. They are arranged for either belting, direct connection, or gearing. The Keystone Company's bulletins show machines of various types and of excellent design. The company also makes an enclosed type of machine which is especially adapted to service requiring dustproof and waterproof construction.

ELECTRICALLY-DRIVEN LATHE.—The Prentice Brothers Company, Worcester, Mass., is building a lathe which is driven by a 3-hp constant-speed electric motor attached to the bed, motion being transmitted to the spindle through gearing. The lathe is started, stopped, or the motion reversed, and at an accelerated speed, entirely independent of the motor, by a lever attached to the apron. This lathe is illustrated and described in a leaflet issued by the company. The company's Pan-American souvenir, which is gotten up in neat pamphlet form, gives illustrations of interior views of the company's shops, also an exterior view, in addition to views of the various styles of drilling machines and engine lathes manufactured by it.

NEW ENGLAND MOTOR COMPANY.—The bulletins of the New England Motor Company, of Lowell, Mass., show a line of well designed, direct current, multipolar motors and generators. The motors are made either partially or completely enclosed. The company also manufactures a line of semi-enclosed and dust-proof bipolar motors, covering a wide range of speeds, and a complete line of slow speed motors and generators of modern design suitable for direct connected outfits, printing press and ventilating service. The company calls attention to the fact that its machines are manufactured with a cradle support, which is covered by a fundamental patent issued to Mr. James Burke and purchased by it, patents on improvements being issued directly to the company last March.

STORAGE BATTERY CATALOGUE.—The distinguishing features and construction of the Gould storage battery are well described and illustrated in an attractive booklet of 12 pages recently issued by the Gould Storage Battery Company, 25 West 33d Street, New York City. Those who are not familiar with the process employed in the manufacture of the plates of this battery will find interesting reading in the pages of this little work. The design of the booklet is rather unique. The style is antique. The text is in dark brown ink, the design on the front cover being printed in two colors. The work is the product of the Alwil shop, Ridgewood, N. J., which is owned and managed by Mr. Rae, son of Mr. F. B. Rae, the well known electrical engineer, of New York.

FLEXIBLE SHAFTS.—All those having use for portable drills may be interested in looking over the catalogue of the Stow Manufacturing Company, of Binghamton, N. Y. This concern manufactures flexible shafts for all purposes. The advantage in the use of this shaft is that wherever, on account of the weight or position, it is inconvenient to take the work to the drill, the drill can be taken to the work, thus saving both time and labor. The company also makes a multi-speed electric motor for operating the drills, and for other power work. The company's catalogue is fully illustrated, showing a variety of applications of the flexible shaft, and gives much information on the general subject. It also contains illustrations of the motor, which has been described and illustrated in these pages.

ENLARGING AUTOMOBILE FACTORY.—The factory at present occupied by the Baker Motor Vehicle Company, of Cleveland, was designed for the developing in the experimental stages of the neat little electric runabout which has been described in these columns, and which has attracted widespread attention wherever it has been shown. After producing vehicles at the rate of two per week for more than a year past, the company is amply assured of an increased demand for another year and has completed plans for a large five story brick building. It will be equipped with all facilities for producing all parts of the vehicle, with the exception of the batteries, and its capacity will be sufficient to take care of all demands. During the past few months a very large proportion of the Baker output has been disposed of in New York City.

MESSRS. CHARLES H. BESLY & COMPANY report their foreign trade as very good, many orders being received from South America, England, Germany, Norway and Sweden. Their Mr. Sinclair, who was so well and favorably known among the bicycle trade during the years 1895, 1896 and 1897, at which time he represented them in this line, is now on his second trip around the world selling the well known specialties manufactured by Charles H. Besly & Company, viz.: Gardner grinders, Besly band grinding machines, Gardner die stocks, Badger die stocks, Helmet oil, parallel clamps, Bonanza and Badger oil cups, Helmet bronze spring wire and sheet, and taps of all descriptions. Mr. Sinclair sails Nov. 5, via London, and will visit France, Germany, Russia, India and Japan, returning via San Francisco. As Mr. Sinclair speaks and writes Spanish, Portuguese, Italian, French and German, he is well qualified for such a journey.

LIGHTING THE PAN-AMERICAN.—When the management of the Pan-American Exposition at Buffalo decided to adopt the Frink reflectors for lighting the Railway Station and Transportation Building, they were doubtless thoroughly familiar with the sterling qualities of these famous reflectors, which have radiated light to all parts of the world for nearly half a century, so that the award of a silver medal on their merits would seem only a just recognition of their many valuable points of advantage and superiority in lighting capacity, durability and appearance. These reflectors have been awarded a medal in every exhibition in which they have been entered, and as they are made in every conceivable shape, size and style for every possible purpose, a catalogue of their numerous products is well worth having. A card addressed to Mr. I. P. Frink, 551 Pearl Street, New York, will bring a ready response to any inquiry along the line of light.

THE STOREY MOTOR.—Storey motors and dynamos have been on the market for several years. These machines are made for slow and medium speeds in all sizes, and for direct current. They are especially adapted for ventilating, grinding, buffing, drilling and other like operations. The company makes a specialty of direct connected combinations of all kinds. The Storey motors have been used by the United States Government for three years for driving a special machine where it is necessary to locate the motor inside of a closed iron pedestal. This is an instance of a machine running sealed in the pedestal, besides being sealed itself, and yet gives perfect satisfaction. The peculiar construction of these machines prevents undue heating. Among the advantages of the Storey motor are that it occupies a minimum space for a maximum power, and on account of its compact design and cylindrical form, it is especially adapted for direct connection to all types of machinery or any class of work requiring either continuous or variable speeds. The company's headquarters are now at 226 Carter Street, Philadelphia, Pa.

ELBRIDGE PRODUCTS.—The Elbridge Electrical Manufacturing Company, Elbridge, N. Y., is manufacturing a special line of small dynamos, for which there is an extensive use. Its 450-watt dynamo is designed to supply current sufficient for eight 16 candle-power lamps. It is a substantially built machine of good electrical design, and, used as a motor, gives one-half horse-power. The company also makes a sparking dynamo for gas engines, which displaces primary or storage batteries for igniting the charge in gas or gasolene engines. This machine also is made in the best manner possible, all of the materials used in its construction being the best obtainable. Besides the machines above mentioned, the company makes what it calls the Midget dynamo or motor, which is designed for experimental work. As a dynamo it has an output of about 10 watts, and as a motor it may be run by current from a few cells of battery. In design it is in every way equal to the larger machine above mentioned. The company is also making an arc lamp for illustrating the principles of operation of the lamps used on commercial circuits; also a model transformer for use in schools and laboratories for the purpose of demonstration. The Elbridge Company manufactures other specialties and will be glad to send circulars to any one interested.

MINIATURE LAMPS.—All interested in the art of electric decoration and use of miniature lamps should send for a copy of the new catalogue (No. 1035) of miniature lamps and appliances just issued by the Edison Decorative & Miniature Lamp Department, General Electric Company, Harrison, N. J. This catalogue comprises a complete account of all types of candelabra, special series, and battery lamps, covering the entire field of miniature lamps, including the telephone lamp, automobile lamp, bicycle lamp, etc. Over 400,000 Edison miniature lamps are now annually used and their application is rapidly increasing. One of the latest plans is for central stations to keep a stock of special series lamps (1 and 3 candle-power, plain and colored), with porcelain receptacles for rental to their customers on festive occasions for decorations. The plan popularizes electric lighting and is specially appreciated at Christmas and holiday seasons. In the appendix to this catalogue are chapters on the following subjects: Instructions for installing miniature lamps and receptacles, batteries for miniature lamps, table lighting decoration, house and room decoration, garden and shrubbery decoration, Christmas tree decoration, use of colored lamps, etc. There are profusely illustrated designs and views of electric decorative installations.

PROCTOR VAUDEVILLE is a favorite amusement for New Yorkers and for visitors to the city who wish to spend a casual hour pleasantly. Manager F. F. Proctor is arranging a strong campaign of vaudeville and comedy for the winter season at his theatres in New York, Albany, Montreal and Newark. There will be an enlargement of the vaudeville scope of his amusement scheme as the season advances, and some of the best European acts, as well as all the American headliners, will appear in conjunction with the Proctor Stock Company. At his four New York houses the stock company will continue the revival of well known comedies, with vaudeville interludes between acts. Joseph Arthur's celebrated comedy drama, "Blue Jeans," is scheduled for an early revival, with all the original scenery and mechanical effects, while David Belasco's beautiful production of "Mme. Butterfly," with Mlle. Pilar Morin as Cho Cho San, will continue for several weeks as a ruling attraction on the Proctor circuit. Sandow, the strong man, is one of the first of a long line of great European vaudeville attractions which are booked to appear at these houses, and with some of the best American specialties already engaged, the vaudeville department will be particularly strong. Sunday concerts have been resumed at all of Manager Proctor's New York theatres.

ROENTGEN-RAY WORK.—We are advised by Elmer G. Willyoung, No. 11 Frankfort St., New York City, the well known manufacturer of electrical instruments and x-ray apparatus, that, by a contract recently made with Mr. E. W.

Caldwell, control of the two Caldwell Patents, Nos. 677,498 and 677,499, covering liquid interrupters, has been secured by him. Also that the patent rights covering the Cunningham mercury jet interrupter, described in ELECTRICAL WORLD AND ENGINEER of Oct. 12, has been similarly obtained. Two forms of the Caldwell interrupter and one model of the Cunningham interrupter are being made for the market and are described in a new catalogue of Willyoung x-ray apparatus now in the printers' hands. This new catalogue will contain a number of new and valuable devices in the x-ray line, including a new line of portable x-ray machines, the Caldwell radiographic tube stand and table, the water-cooled tube, etc., etc. A new stereoscopic fluoroscope, the invention of Mr. Caldwell, will also be commercially announced for the first time. Among recent orders for Willyoung x-ray machines are two of his 15-inch type H machines, one for St. Luke's Hospital, New York, and the other for the New York Hospital. These machines will be duplicates of the one furnished Roosevelt Hospital about one year ago, and are wound with extra heavy wire so as to produce especially large volume of discharge.

Record of Electrical Patents

UNITED STATES PATENTS, ISSUED OCT. 22, 1901.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, Times Bldg., N. Y.]

684,785. ELECTRIC ARC LAMP; J. Bouillet, Levallois-Perret, France. App. filed Dec. 20, 1899. Horizontal carbons are fed by means of friction wheels bearing against them and rotated by the lamp gearing.

684,791. ELECTRIC RESISTANCE; E. R. Carichoff, East Orange, N. J. App. filed Aug. 1, 1901. The resistance is composed of looped material suspended in the open air from suitable connecting blocks attached to the bottom of a car.

684,828. SPARK GAP REGULATOR; T. B. Kinraide, Boston, Mass. App. filed March 5, 1901. The main circuit includes a solenoid which controls the length of the spark gap and regulates the discharge.

684,831. PROCESS OF PREPARING SECONDARY BATTERY PLATES; A. Lehmann, Berlin, Germany. App. filed Oct. 10, 1900. The plates are subjected to current while in a bath of fatty acid; the acid is neutralized to cause the organic acid to act in its nascent state; the plates are then removed from the bath and exposed to caustic soda, and after washing they are ready for formation in sulphuric acid.

684,880. INCANDESCENT LAMP BASE; A. Swan, New York, N. Y. App. filed March 6, 1899. A cross-pin passes through the base and projects at each end as a means to hold the base in the socket.

684,881. RAILWAY SIGNAL; H. B. Taylor, Newark, N. J. App. filed Aug. 7, 1900. A three-position semaphore signal controlled by locking devices and circuits actuated by the train.

684,906. ELECTRICAL RECIPROCATING APPARATUS; John Brown, Belfast, Ireland. App. filed July 10, 1900. Details.

684,909. INSULATING BUSHING; J. A. Cole, Boston, Mass. App. filed Aug. 10, 1901. A bushing adapted to be inserted in an opening in sheet metal to carry an insulated wire. The bushing is sprung through the opening and is self-locking when in place.

684,950. ELECTRIC MINE LOCOMOTIVE; C. Robinson, Columbus, O. App. filed Sept. 14, 1895. Details of the frame and mounting of the motors.

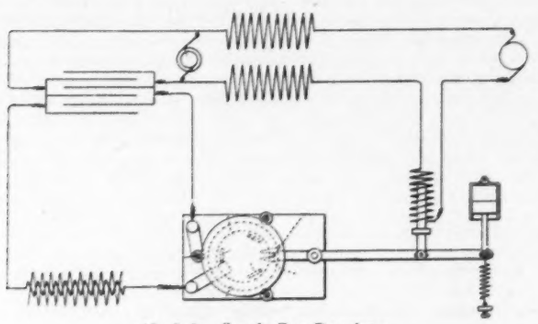
684,952. STREET RAILWAY SIGNALING SYSTEM; J. J. Ruddick and C. E. Rand, Newton, Mass. App. filed Feb. 27, 1899. A plan of circuits and signals for automatically protecting the blocks by the moving cars themselves.

684,963. TELEPHONE INSTRUMENT; Willis W. Washburn, Chicago, Ill. App. filed Nov. 5, 1900. A horseshoe magnet has one of its ends provided with a solid pole piece and the other with an annular pole piece enclosing the former. The annular pole piece is screwed in the telephone head, and the coil is arranged between this and central pole piece.

684,968. SIGNAL; J. A. Wilson, Chicago, Ill. App. filed Sept. 23, 1899. A belt driven by a motor at the signal post is adapted to be automatically clutched and unclutched to and from an arm which moves the signal.

684,969. RAIL BOND; H. W. Wyman, Worcester, Mass. App. filed March 20, 1901. The lug at the end of the bond passes through and slightly beyond the rail; a wedge driven into an orifice in the lug spreads it on the distant side and prevents it from moving.

684,977. ELECTRIC BELT; A. Chrystal, Marshall, Mich. App. filed Aug. 19, 1901. Details.



684,828.—Spark Gap Regulator.

685,008. ELECTRIC SIGNALING SYSTEM; J. J. Ruddick, Newton, Mass. App. filed June 20, 1899. A railway signaling system in which the signals are placed on the cars and automatically operated to inform the motorman so that he may go onto a siding if another car is in the same block with him.

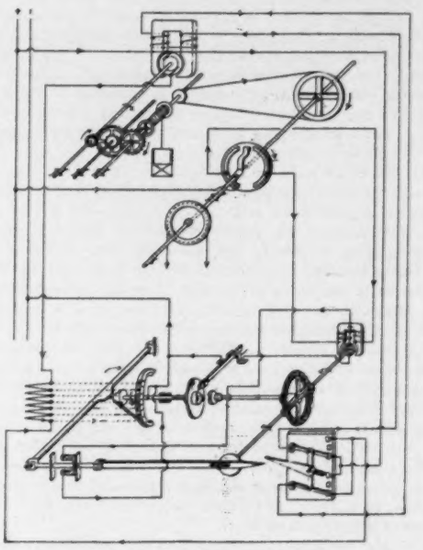
685,012. MEANS FOR INCREASING THE INTENSITY OF ELECTRICAL OSCILLATIONS; N. Tesla, New York, N. Y. App. filed March 21, 1900. Renewed July 3, 1901. (See Current News and Notes.)

685,034. PARTY-LINE TELEPHONE SYSTEM; Wm. W. Dean, Chicago, Ill. App. filed April 28, 1899. (See page 729.)

685,042. ELECTRIC FURNACE; W. T. Gibbs, Buckingham, Canada. App. filed Oct. 14, 1897. (See page 730.)

685,043. ELECTRIC METHOD OF FUSION; W. T. Gibbs, Buckingham, Canada. App. filed March 15, 1901. (See page 730.)

685,046. CABLE HANGER; W. H. Johnston, Chicago, Ill. App. filed April 1, 1901. Improvement in the buckle for holding the ends of the strap together.



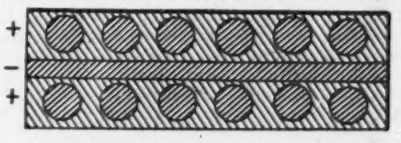
685,072.—Arrangement for Controlling Electric Elevators.

685,072. ARRANGEMENT FOR CONTROLLING ELECTRIC ELEVATORS; E. A. Wahlstrom, Cannstadt, Germany. App. filed Aug. 25, 1899. Switches on each floor corresponding to the number of floors, means being provided for preventing the actuation of any switch while another is in use.

685,101. ELECTRIC BATTERY; P. Chapuy, Vincennes, France. App. filed Feb. 21, 1901. One electrode in the form of cylinders or rods is embedded in a block of porous, non-conducting material, the other electrode being a plate confined between two of the blocks.

685,118. TROLLEY; A. J. Eberwine, Slatington, Pa. App. filed Aug. 8, 1901. Details.

685,155. SYNCHRONISM INDICATOR; Paul M. Lincoln, Niagara Falls, N. Y. App. filed March 27, 1901. Two coils are mounted at right angles on a revolvable axis and are in a field maintained by current in a coil connected to the station bus-bars. The revolvable coils are connected with the machine to be synchronized by means of two branch circuits, one of which contains a non-inductive and the other an inductive resistance, this disposition producing a difference of phase in the two coils. The patent describes automatic means set in operation by this device, for closing the paralleling switch, which switch is provided with a safety element preventing its closing except during such time as the dynamos are with respect to synchronism within a margin of safety.



685,101.—Electric Battery.

685,156. GOVERNOR MECHANISM; P. M. Lincoln, Niagara Falls, N. Y., and L. B. Stillwell, New York, N. Y. App. filed May 11, 1901. (See Current News and Notes.)

685,239. APPARATUS FOR RECORDING AND REPEATING TELEPHONIC SPEECH; Harry A. Rhodes, Denver, Colo. App. filed Jan. 2, 1900. (See Current News and Notes.)